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CONTENTS.

EDITORIAL:
Gas and Electricity 947
Engineering Honor 947
The Telephone Industry 948
The National Electric Light Association Convention 948
Are Volcanoes Due to Radium? 949
For Better Lighting 949
The Twenty-ninth Convention of the National Electric Light Association 950
Illuminating Engineering Society 960
Programme for the English Trip of American Engineers 960
Mr. Arthur Williams, President of the National Electric Light Association 961
What Constitutes Good Advertising 961
The Self-Synchronizing of Alternators, by Morgan Brooks and M. K. Akers 962
Notes on the Lighting of Churches, by Edwin R. Weeks 963
The West Allis Plant of the Allis-Chalmers Company 964
Electrical Power for the Textile Mills of India 967
Colorado Electric Light, Power and Railway Association 967
Engineering Honor, by Schuyler Skaats Wheeler 968
The Faraday Society 970
Some Physiological Factors in Illumination and Photometry, by Louis Bell 971
The Ever-Present Telephone 973
REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE 974
ELECTRICAL PATENTS 976
Electricity and Gas *versus* Smoke 976
METHODS OF GETTING NEW BUSINESS 977
INDUSTRIAL SECTION:
Westinghouse Motors 978
Niagara Falls from an Economic Standpoint 980
New Electrical Power Schemes for India 980
CURRENT ELECTRICAL NEWS 981

GAS AND ELECTRICITY.

Gas and electricity are usually looked upon as competitors. The dealer in each claims that it is the best or cheapest, or the best and cheapest, illuminant. No doubt, in some cases one is right and, in some, the other; but it does not require a great imagination to look a little forward and to see these two agencies working hand in hand in our cities. Electricity has, unquestionably, certain advantages for lighting purposes. On the other hand, considered merely as a source of heat, gas must, for some time to come, be the cheaper. For years our cities will not be able to do without fuel in some form, and gas is the most convenient and cleanest method of supplying this.

It has been suggested—and the suggestion is a good one—that the gas supply companies turn their attention more and more toward supplying fuel and less toward giving light. If they should do this entirely it would be feasible to supply a cheaper form of gas, which might drive coal entirely out of the cities. It is even possible that the electric generating stations would themselves use gas for fuel in preference to coal, thus securing the high thermodynamic efficiency of the gas engine and, at the same time, avoiding other troubles incident to the use of coal. The idea would be for large gas manufacturing plants to be erected outside of the city, possibly at the mines, where the gas would be generated and transmitted to the city. Here it would be supplied to the power-houses and all the city buildings for use as fuel, while at the power-houses electrical energy would be generated for supplying the lighting and power for all the city work. It is possible that eventually electric power may displace all other forms of energy for city purposes. This is what we are all looking forward to. All we need to discover or invent is some method of transforming the energy of fuel directly into electricity. In the meantime, this alliance between gas and electricity would be a long step forward toward the smokeless, horseless city.

ENGINEERING HONOR.

Dr. S. S. Wheeler performed an invaluable service to the profession of electrical engineering when he presented his address at the recent convention in Milwaukee. He took for his subject, "Engineering Honor," but he dealt more particularly with the conditions obtaining in the branch known as electrical engineering. Certain of the older engineers say that there are only two branches of engineering—military engineering and civil engineering. However just this contention may be, practically the division is a convenient one, since both in study and in practice one person must limit himself to a rather restricted field.

The older branches of the profession have recognized, more or less definitely, certain codes of ethics to guide their action, but the electrical engineers have not yet taken any such action, though it is very desirable that this be done. It might be held by some that the codes recognized by the other branches of engineering could, and should, be used as guides, but the conditions confronting the electrical engineer differ from those which the other branches have to face. Due to the way in which the commercial development has taken place, a good number of the more prominent electrical engineers are more or less closely connected with certain manufacturing concerns, or are identified with certain electrical methods or processes. For this reason it is all the more desirable that the electrical engineer should take some definite stand regarding what conduct may be considered professional, and what not.

In another way this action is desirable. It is regrettably true that the public, as a whole, has not yet accorded to the

engineer that high position as a professional man which the lawyer and the doctor enjoy; and in the engineering profession itself the older branches still show a tendency to belittle the electrical man, treating him either as a scientist who stoops to practical work, or, more often, as a mechanic who aspires to higher things. For these reasons the action taken by the Institute in appointing a committee to report upon a code of ethics will be beneficial, for it will help to raise the profession as a whole in the eyes of the public and electrical engineering in the eyes of the older branches.

THE NATIONAL ELECTRIC LIGHT ASSOCIATION CONVENTION.

The twenty-ninth convention of the National Electric Light Association, held at Atlantic City, N. J., June 5 to 8, reflected the very active work which the officers had done during the past year in increasing the interest and membership in the organization. The attendance, which was far in excess of anything previously recorded, must have been particularly gratifying to the master of transportation. The arrangements for the registration of guests were very complete, and the distribution of papers was facilitated, to a high degree, by the efficient corps of workers constantly on hand at association headquarters. About the usual interest was manifested in the discussion of the technical papers, but the discussion relating to the commercial development of central station supply was disappointing, in that but little time was left after the reading of the papers. The extremely complete and interesting paper prepared by John F. Gilchrist, on the "Free Installation of Electric Signs," was abstracted very hurriedly, but little time being given to a discussion of this important subject. The suggestion was made several times by attendants at the technical sessions that the papers to be presented at each session be distributed to the members at the session prior to their reading. They could then be assimilated, and all that would be necessary would be an abstract by the author, leaving a great deal more time to discussion. It is truly remarkable how much work was accomplished, and the smoothness with which each session proceeded was a tribute to the exceptional ability of Mr. Blood as a presiding officer. Concerning the choice of the new executive, no further comment is necessary than to say that it represents one of the most popular selections with which the association has ever been favored.

The suggestion voiced by Mr. Blood in his presidential address, that an expert be employed to act with the underwriters in conserving property interests, is heartily endorsed by the fire insurance fraternity, and will no doubt be of great benefit to the association.

The keynote struck by President Blood in his address concerning the attitude of public-service corporations toward the consumer was emphasized in the fine address made by Everett W. Burdett on the agitation for municipal ownership and its remedies. Mr. Burdett has made a close study of this subject and his clear analysis of the conditions leading up to this agitation for municipal ownership; his able exposition of the elements of failure which have attached to those alleged successes of municipal ownership abroad, and his edifying conception of the straightforward means the supplying corporations must take to gain and hold the confidence of the consumer, make his address a valuable addition to the literature of the subject.

THE TELEPHONE INDUSTRY.

The special report of the Census Bureau, dealing with the telephone industry in this country, shows the remarkable development of this industry up to 1902. From all indications, the development during the past four years has been even more surprising. The statistics show that at the time the compilation was made there were 2,315,029 telephone stations of all kinds. During that year the American Telephone and Telegraph Company reported 1,110,000 stations served by the Bell companies. In the report issued by this company on the first of January of the present year it is shown that on that date there were 2,530,000 Bell instruments in use, an increase of 2.3 times in four years. A similar increase in the number of independent telephone instruments would make the total number of telephones over 5,000,000. As the number of calls during the census year was over 5,000,000,000, by assuming the same ratio of calls to instruments, we would get as a first approximation about 11,000,000,000 messages or talks given or held in a single year by a system of communication only thirty years old.

The report gives also some interesting load curves. They show, in general, two peaks, the first coming in the forenoon at about ten o'clock in a large commercial centre, and at about nine in a manufacturing town. The second peak is in the afternoon, lasting from two to four in the commercial city and from four to six in a manufacturing town. In a small village the load curve takes a different shape, but still shows two peaks, the first coming at eleven A. M., and the second at three in the afternoon. There is a third peak, less pronounced, coming in the evening. In the case of the manufacturing town it is very decided, although the number of calls then is less than the steady load during the middle of the day. In the case of the large city this peak is not so pronounced, and is found to be due to an increase in the number of calls arising from the residential district. The village shows a similar peak, coming earlier in the evening. No doubt, these load curves are indicative, in a way, of the life in these various localities. There is, for example, a very considerable number of calls made during the small hours of the morning from the residential section of the large city, which seems to have no counterpart in the village load curve. These, however, are sociological questions. The telephone man is interested, not in knowing why such calls are made, but in the fact that they are.

A study of this report is impressive, not only on account of the enormous increase in the telephone business itself, but also on account of the remarkable development which has taken place in the apparatus and in the methods of conducting the work. It is hard to conceive that this remarkable progress has taken place in only thirty years.

ARE VOLCANOES DUE TO RADIUM?

New applications of new physical conceptions are always interesting when there is any ground for them. Every new discovery in science is followed by multitudes of letters or articles appearing in the newspapers or journals, applying the new ideas to explain many physical manifestations which, to the writers, seem to need new treatment. By far the greater number of these discussions are of little or no value. The authors seem to know little about the subject they are discussing, and it is the novelty of the idea, rather than its scientific value, which appeals to their imagination.

On the other hand, every new discovery in science necessarily suggests explanations of phenomena hitherto unexplained, or offers an idea of the action which seems to be nearer the truth than the one previously held. The discovery of radioactivity naturally was followed by many attempts to utilize the new conceptions in explaining long-known facts. Many of these ideas have been of much value, and the more we learn about radium and its allied elements, the wider does their possible field of action seem to become. A flood of light is let in on ground hitherto obscure, so that the scientific view takes on a different aspect, and phenomena which before seemed entirely dissociated now seem to be closely related.

One of the latest interesting uses of the idea of radioactivity is due to Major C. E. Dutton, of the United States Army, who thinks that it offers the long-sought-for explanation for volcanic action. While a discussion of volcanic action may seem to be a little out of the province of the electrician, when the volcanist adapts to his purposes phenomena closely allied with electrical reaction, the former has some excuse for showing an interest in the discussion. Since, therefore, Major Dutton turns to radioactivity to explain a phenomenon which he has studied for many, many years, the electrical man is justified in indicating his interest.

In brief, Major Dutton's argument is this: The body of molten lava which is thrown out of a volcano is insignificantly small compared with the bulk of the earth, and for various reasons which he has set forth at length during the past twenty years, this lava, he believes, is contained in a shallow reservoir. If these facts are admitted, it seems inconceivable to Major Dutton that this molten rock can have existed for the æons during which the earth has been cooling from a molten condition, for ages ago such small masses would have become solid. Some explanation must therefore be found to account for the molten mass. He suggests that radioactivity is this agent, for radium is known to be present in the crust of the earth. It is known to develop heat, which, if not conducted away as rapidly as it is set free, will accumulate. If this accumulation goes on for a sufficiently long time and at a sufficiently high rate, the rocks where this action is taking place will eventually melt and water, which is always present, will be transformed into steam, and the lava extravasated. After relief has been found in this way the accumulation of heat will begin again, and the eruption repeated at a later period. From the small amount of data which have been accumulated, it is believed that the amount of radium contained in the earth's crust is sufficient to develop the heat required by this explanation.

This is a neat application of the theory of radioactivity. It seems to fit the case very prettily. The next step necessary will be to investigate the radioactive phenomena of volcanoes, for a confirmation of this theory would be of world-wide interest. Who knows but that before many years have passed we will be able to draw up a schedule of the volcanic eruptions to be witnessed for a long time to come, and thus take time by the forelock, avoiding the destruction of property in the surrounding country, or even running excursions to view the magnificent phenomenon. All that will be necessary will be for us to know the amount of radium present and the physical characteristics of the volcano's interior.

FOR BETTER LIGHTING.

It is only recently that we have paid much attention to the proper methods of illumination, but since the importance of this subject was pointed out, the various aspects of the problem have been discussed at frequent intervals. One of the important phases which had not previously been thoroughly discussed was taken up at a recent meeting of the Illuminating Engineering Society, in a paper presented by Dr. Louis Bell, on the physiological effects of our methods of illumination. This is really one of the most important phases of the subject, for our main reason for lighting a building is to enable us to see. The other results, while important, are secondary. And it is not only necessary that we should be able to see, but that this should be brought about by that method least harmful to the eye. Every one is aware of the unpleasant feeling produced by a badly placed light, yet we seem to fail to realize that not only is that arrangement uncomfortable, but it is probably injurious. We seem to take such situations as a matter of course, and we make no attempt to rectify them. Then, again, it is very common to find inadequate lighting in a room where the eye must be used for hard work, such as reading. We are apt to think that if a certain number of lights are placed in a room that is all that need be considered.

The problem really is a very complex one. We must give an illumination which puts the least strain on the eye, and, in nearly all cases, we must do this for the least cost. We should also bear in mind the æsthetic side, and produce an effect as harmonious as possible. This latter problem is closely connected with the first, for a pleasing effect is less tiring to the eye than one that is too dull or too glaring.

We seem now to have made a fair start toward improving our lighting system throughout, for we have got together not only the men interested in supplying the illuminant itself, but those who decide how it shall be used; and now we find the oculists and others who are particularly concerned with the care of our eyes adding their influence. This united effort should have a considerable effect in educating the public to a proper use of illuminants.

The Twenty-ninth Convention of the National Electric Light Association.

Atlantic City, N. J., June 5 to 8.

IN POINT of number of attendants, the twenty-ninth convention of the National Electric Light Association, held at Atlantic City, N. J., June 5 to 8, was a record breaker, there being registered up to Thursday evening nearly 1,500 delegates and guests. The Tuesday and Wednesday sessions were reported very fully in last week's issue of the ELECTRICAL REVIEW, and a brief summary given of the last two days' sessions, including the election of officers, which resulted as follows:

President, Arthur Williams, New York, N. Y.

First vice-president, Dudley Farrand, Newark, N. J.

Second vice-president, Alex Dow, Detroit, Mich.

Secretary and treasurer, W. C. L. Eglin, Philadelphia, Pa.

Executive committee, to serve for three years: Charles R. Huntley, Buffalo, N. Y.; F. M. Tait, Dayton, Ohio; L. A. Ferguson, Chicago, Ill.

The session opened on Tuesday, June 5, with the address by the president, W. H. Blood, Jr. The papers taken up included the report of the "Committee on Progress," by T. C. Martin; "Mercury Arc Rectifier System with Magnetite Lamps for Street Illumination," by W. S. Barstow; "The Flaming Carbon Arc," by Louis B. Marks; the report of the "Committee on Steam Turbines," by W. C. L. Eglin and I. E. Moultrop; "Mechanical Refrigeration," by John Meyer; "Fuel Economy," by J. H. Hallberg; "Electric Heating," by James I. Ayer; "Line Construction for Overhead Light and Power Service," by Paul Spencer; "Business-Getting Methods," by Frank W. Frueauff; "How to Make a Small Electric Plant Pay," by D. F. McGee; a symposium entitled "Some Methods Used in Securing and Retaining Business"; "Free Electric Signs," by John F. Gilchrist; "Profitable Commercial Cooperation," by J. Robert Crouse; and the report of the "Committee to Cooperate with the Manufacturers' Advertising Committee"; "Grounding Secondary Alternating-Current Service," by Sidney Hosmer; report on "Protection from Lightning During 1905"; report of the "Committee on the Fire Hazard of Electricity."

THURSDAY MORNING, JUNE 7.

President Blood called the meeting to order at 10.15 o'clock and announced the first paper on "Alternating-Current Systems of Distribution and Their Automatic Regulation," by C. W. Stone.

The first part of this paper deals with the various methods of alternating-current distribution now in use; the latter part takes up the question of automatic regulation.

Regulators are divided into two types, those that are arranged to work directly or indirectly to change the potential of the generators, and those for operating directly on the feeders. A number of such regulators are described.

H. L. Wallau said his company was operating in Cleveland an 11,000-volt transmission system, and had a grounded neutral both at the main station and at all substations. He asked Mr. Stone if he thought there would be trouble from stray currents due to railway circuits, due to these conditions. The practice in Cleveland had been to use for primary circuits three-phase, three-wire circuits straight through. The principal distributing mains are also three-phase, three-wire, but there are some single-phase distributing mains that run down short cross streets and through the back alleys. The question of secondary distribution has been very forcibly brought home by the large number of transformers of small capacity that began to accumulate upon the primary systems, and it became necessary for that reason to adopt a definite policy of secondary distribution. In one of the very congested districts in the west side of the city there is a comparatively large district, with approximately a 400-kilowatt load at maximum, which is distributed entirely underground by a three-phase, four-wire secondary system, the primary being three-phase, three-wire, 2,300 volts, and the secondary 115-200 volts. As originally installed this secondary was pretty well balanced, but as connections have been made and customers disconnected, it is found that the balance becomes quite bad and the regulation on that type of secondary is getting to be a very hard thing to maintain. For that reason the three-phase, four-wire system has been discarded except where it exists and can not readily be changed, and the single-phase, three-wire secondary system has been adopted. Where there were long stretches, individual sections or streets were balanced on a given phase of the feeder, the next section being on the next phase, etc. For small power loads additional transformer capacity is installed. However, but one power transformer is installed. That is simply to get the other two phases, as the power that is supplied in these districts is to a large extent very small compared with the total lighting load on the secondary system at that point. The transformer is therefore connected either to give 115 volts, three-phase, where the motors of that type exist, or 230 volts, three-phase, when necessary, by connecting the additional transformer with the three-phase wire connection and running two additional wires. The company is about to install a turbine in this connection and an exciting set with a Tirrill regulator. It has been decided, however, that regulation is not possible from one principal feeder, for the reason that there are now three substations in use and a fourth being built, and the total number of feeders to be supplied by these substations will be something like thirty-three next fall, and it is expected that the average load on the feeders will be from 150 to 200 kilowatts, and as the substations are located quite a distance apart it is pretty hard to regulate any particular feeder to give any kind of regulation on the others. Compensators have been adopted having one compensator cut in each leg of a three-phase primary feeder and one induction regulator in each leg of such feeder. The regulators are motor-operated, but controlled by the station operator, who merely adjusts them, to keep his potential balanced as shown on the station voltmeters. Very little difficulty has been found in obtaining good regulation by this means and rather better efficiency is got out of the transmission lines insomuch as the three-phase system, with its resulting economy, is used, as against the single-phase system balanced on a three-phase bus.

Mr. Stone said he did not think there should be much trouble on the three-phase grounded neutral, 11,000-volt circuit, because the principal trouble which occurs on the three-phase, four-wire primary distribution is due to the great number of grounds which are made very close to the railway circuits; he would imagine with the one ground that the substation, which

is probably a considerable distance from the rails, and a considerable distance away from the railway circuits, would experience very little trouble.

J. H. Hallberg, New York, said that in one large power station where they were using the three-phase, four-wire grounded neutral, overhead system, they experienced a great deal of trouble with the lightning arrester equipments. He thought that that point deserves some consideration, because when a lightning arrester is applied to a system with a grounded neutral, it must not be forgotten that the entire circuit potential exists between each phase-wire and the ground, so that a double-pole arrester should not be used, because when the lightning does strike it it does not merely go from one of the phase-wires to the ground, as would occur in an underground circuit, but it also establishes a path for the current between two phases, and therefore it is better on such systems to use the lightning arresters in tandem, single-pole arresters, one placed after the other. That gives a much better result; otherwise the current is liable to jump across the arresters, which has happened in several instances he knew of.

Another thing he was interested in was the three-wire four-phase primary distribution and the single-phase secondary system of distribution with three wires. He believed that a system of this sort is applicable to all classes of work, and especially now that single-phase motors are available which can be operated up to capacities of fifteen horse-power for elevator work and other classes of service, such a system should certainly deserve careful consideration.

J. F. Geiser, Waynesboro, Pa., said he was very much interested in the question of feeder regulators, not because of any experience that his company had had, but because at the present time they were about to light a park some six miles from the town and it was desired to install as simple an apparatus as possible for taking care of the losses on the line. The company has been looking for just such a regulator as was described in the paper, and he would like to get as much information as he could about the nature of the apparatus, the amount of potential it requires, etc. He asked Mr. Stone if they were in general use at the present time and whether they required frequent inspection or any regular attendance. The park season is only a few months in the year and they could afford to suffer considerable loss in the feeders for the short period of time if the loss did not disturb the lighting.

Mr. Stone stated that a large number of these automatic regulators were in use. There are many in Chicago and a number in Toledo. The first regulators which were put out required considerable attention, but at the present time he thought it could safely be said that they require but very little attention and the maintenance should be very slight. With the switch type of regulators there has been practically no wear whatever on the switch after two or three years' successive operation under commercial conditions. The only maintenance would be to see that the bearings were well oiled and that the contacts on the potential relay were in good condition. If these two things are looked after, he expected very little trouble to occur in the case of either type of regulator.

The next paper, "Maintenance and Calibration of Service Meters," was read by William Bradshaw.

The modern integrating wattmeter has reached a stage in its development where the user's share of attention is reduced to a minimum. Nevertheless, careful and intelligent inspection and calibration are necessary and a never-failing source of revenue.

The efficiency of the maintenance bureau may be materially increased and its cost reduced to a minimum by giving the proper attention to the following points:

(a) The selection of the meter.

(b) The installation of the meter.

(c) The record system.

Meters should be selected according to the excellence of their mechanical construction and electrical performance. The mechanical features which permit good electrical performance are the lightest moving element consistent with strength, bearings with a minimum of friction and a maximum life; a construction of terminals that provides good surface insulation between opposite sides of the line and to ground and make it difficult to tamper with the registration of the meter; coils so insulated as to prevent grounding to laminations and burnouts.

Some features affecting the meter's electrical performance are a design of electromagnet that will give a load curve accurate within the limits of plus or minus two per cent from two per cent of full load to fifty per cent overload; a voltage curve accurate within same limits from fifty per cent of voltage to twenty-five per cent over-voltage; a frequency curve with an accuracy of two per cent for a change of ten per cent of alternations. It should have low shunt loss, high ratio of torque to unit weight and a very small change in accuracy for a large change in temperature.

The installation of the meter should take advantage of its inherent overload capacity and should be made in an accessible place, free from excessive vibration, moisture, or extreme ranges of temperature.

The maintenance bureau will have for its principal work a periodic inspection and test of its service meters. This can only be accurately and well done when properly systematized. Record cards, giving the head of the meter department at a glance the condition of the entire meter equipment, should be used.

The most efficient and cheapest method of making the periodic inspection and test consists in using such apparatus for the line test that the services of but one man capable of performing both inspection and test are required. Secondary standards with which the line test can be easily and accurately made are now available in the form of special integrating wattmeters. The method of this line test consists in comparing the speeds of the moving element of the service meter and the standard. When used with discretion, it is the most accurate and reliable method available. The special integrating meter should never be considered as anything but a secondary standard and then only when its calibration is frequently checked by a reliable and accurate primary standard.

The laboratory work will consist, first, of test and repairs on service meters, the line test and inspection of which have indicated the need of more extensive repairs and calibration than can be made at the installation; second, of the care and calibration of the secondary standards. The most important and vital work of the maintenance bureau and laboratory of the central station is the proper use and calibration of the secondary standards and the care and use of the primary standard.

In selecting a secondary standard choice should be made of the meter which shows the best average performance for both load, voltage and frequency, and the limits of variation should not be greater than specified for service meters.

The primary standard determines the accuracy of the entire bureau's work and its reliability and permanency are of vast importance. The service meters have an inherent range of seventy-five times its smallest calibrated reading and the primary standards must cover the range limits of the entire line of service meters in

use by the station. The manufacturer or some standardizing laboratory should calibrate and maintain the primary standard.

Dr. Edward Weston, Newark, N. J., asked Mr. Bradshaw whether the curves shown in his paper are intended to represent the errors due to the spring in the Siemens' dynamometer, or whether they are the combined errors of the instrument. He has had quite a little experience with springs and also dynamometers, and he certainly found the springs rather more reliable. In fact, you must expect to find in instruments of the dynamometer type errors which are due to causes other than those due to the springs, especially in Siemens' type of dynamometer, where the coil is immersed in mercury in order to insure contact; but in addition to that the Siemens' type of dynamometer is not such a type as gives the coil a fixed position with relation to the rest of the field. That induces an error. Springs are extremely accurate and reliable devices if properly made. The best indication of that is that our steamboats, our vessels all over the world, are steered according to time derived from a chronometer, and in that case the spring force varies so minutely that it is practically inappreciable. Of course, any difference due to temperature is compensated for by the compensating balance. In the use of springs on timepieces the error due to the very minute variations of the spring is accumulative, for its effect is increased with each beat of the balance-wheel; whereas in using the spring for obtaining a balance, or a condition of equilibrium, that practically does not count at all. The Siemens' dynamometer type of instrument is not an unreliable instrument on account of its spring, but on account of the nature of the instrument, the effective character of design and the method of inducing the current through the coils. He ventured to say that springs properly constructed will show an error of less than one-tenth of one per cent, or even one one-hundredth of one per cent, but they should not be tested by the application of anything in the way of electrical current or the introduction of elements which properly do not belong to them mechanically. They should be tested by the application of a weight at a known distance from the centre, that is acting upon a drum carefully counterbalanced at a known distance from the centre. Mr. Bradshaw makes the statement that manganin, which he (Dr. Weston) had the pleasure of discovering a good many years ago, and which is being universally used in resistance coils, is constant, and if it shows any change at all it shows a tendency toward decreasing resistance rather than increasing it. That is not a fact, sometimes it goes up and sometimes it goes down, and the variations, while very small in general, are sometimes quite considerable. It is more marked apparently with thin wires than with thick wires, so that too much reliance must not be put in manganin standards of resistance, and they must be checked from time to time. He has had some cases of manganin standards which have been in his possession for a matter of perhaps fifteen years and they have shown as much as ten per cent increase. That is a very serious change, but invariably that has occurred with thin-wire standards. When it came to thick-wire standards the error generally has been very small, but it is not always one way.

Mr. Bradshaw replied that the curves given represented the accuracy of a spring when its torque was exactly proportioned to the current deflection, and they do not by any means come any closer than the statements given. If only one spring is taken, it will show considerably more variation than one-tenth of one per cent, but if two springs are taken, a man who has had a great deal of experience with springs may be able to set the springs so that they will approximate closely to a straight line. The curves deal with the accuracy of the spring itself and not with the accuracy of the instrument as regards the deflection and torque of the spring.

The paper on "Alternating-Current Elevators," was read by W. Noble Dickinson, Jr.

Summarized and compared, the application of the alternating-current motor to the regular type of direct-current direct-connected elevator machine limited the duty of the latter and rendered it expensive to install and to operate. It also made it noisy in operation, detracted from its safety, necessitated mechanical or rectified magnetic control, and affected the lights when placed on a lighting circuit. On the other hand, the tendency of central stations toward alternating current made it clear that alternating-current elevators suitable for all classes of service would be called for, and that if real progress was to be made, existing conditions and known principles must be carefully analyzed and the latter applied to the former, singly and in combination, until a basis of present possibilities was established. This basis should constitute at least an advanced starting point for development.

Applying, in so far as possible, the experience gained in direct-current practice, it followed that the first requirement was a quietly running motor having a large starting torque per volt-ampere of input, a reasonably small rotor weight, and good efficiency and power-factor through a range of load. It further appeared that a motor having direct-current shunt motor characteristics at full speed was necessary and that if possible this motor should be subject to definite speed variation. The multiphase motor, as known, gave better promise than the single-phase motor of fulfilling the conditions, and the multiphase elevator was, therefore, taken up first.

The elimination of noise, the obtaining of an excellent efficiency and power-factor at full load, and the reduction of rotor weight and speed to the minimum, could be provided for in the design and manufacture of the motor. The starting torque and speed variation features did not so readily fall into line. The starting torque per volt-ampere was improved, but was not and has not as yet been brought to a point comparable with that of the direct-current motor.

An induction motor has practically the same characteristics as the direct-current shunt motor and, with all resistance cut out of both primary and secondary circuits, the speed of the induction motor is limited quite as well by the number of cycles on the circuit as the speed of the direct-current motor is limited by the line voltage.

In the event of the line circuit being broken, however, the comparison ceases. Under such conditions the speed of the induction motor would be limited only by the relation existing between the driving force and the mechanical friction opposing it. With highly efficient gearing and mechanical control, the failure of the current with the machine in operation or the lifting of the brake with no current on the line would prove a source of danger. The introduction of an electric brake would at once overcome this difficulty.

The imminence of phase reversal on the line is not so apparent as it was some time ago, but it is clear that danger from this source on multiphase circuits exists and always will exist and that provision should be made to nullify its effect. With a magnetic control, perhaps the best device for automatically accomplishing the desired result makes use of the torque principle of a small multiphase motor inserted

across the main line circuit. With current across this small motor in the proper relation, the circuit to the elevator controller is complete, but at the instant the phase relation on the main line circuit is reversed, the direction of torque is reversed and the control circuit is, in consequence, opened.

The problem of magnetic control has practically been solved. Something over a year ago a multiphase magnetic control was set up and operated, and its action was positive. Chattering was obviated by the use of four-pole magnets acting on circular armatures.

For ordinary controls, a single-phase magnet of the solenoid type has been developed, which is simpler in construction and wiring, and lends itself more readily to the requirements of a control.

With the controller magnets developed, the next step was to reduce the current required to release the brake and, if possible with safety, to provide that the brake-releasing current should not occur simultaneously with the peak of the motor-starting current. This end has been attained by proper connections in the controller and by the introduction of a momentum type of brake in which the turning effort produced when the friction shoes of the main brake grip the revolving brake-wheel is transmitted to the lever of a second brake which also tends to bring the moving parts to rest. As the braking effort is thus multiplied, a smaller brake magnet meets the requirements, and, in consequence, a smaller brake magnet current.

Utilizing these single-phase control magnets and a multiphase brake magnet, any form of "switch-in-car" or "push-button" control for a multiphase elevator may be obtained, without employing a rectifying process, and it is clear that this same combination is equally applicable to the control of a single-phase elevator by including a phase-splitting device to supply multiphase current to the brake magnet.

The starting current for an alternating-current motor suitable for elevator work is greater than that of a direct-current motor, but it seems reasonable to assume that in any location in which high-speed service is demanded, provision for a high-starting current may be made.

High-speed service requires some form of control for intermediate speed, in order that good landings may be made. The introduction of a double or multi-motor arrangement with provision for individual and cascade connection, or with one electrodynamic machine arranged as a power consumer, appears to offer the best promise for definite speed control.

P. D. Wagoner, Schenectady, N. Y., took exception to Mr. Dickinson's statement, in connection with the use of mercury arc rectifiers in connection with elevators, that the current required to maintain the arc during the period in which no useful work is being done usually represents a loss which is prohibitive. Mr. Wagoner felt that in this instance at least the word "prohibitive" is comparative. It is possible to maintain the arc during the period referred to by Mr. Dickinson with a loss of energy not exceeding 100 watts, perhaps by something less than that amount, and there are many cases when the advantage of being able to use direct current would more than offset the energy equivalent to one or two incandescent lamps. With reference to the use of the rectifier in connection with storage batteries, it is entirely possible that rectifiers may be applied to this service without the use of any storage battery at all. This belief is founded on the fact that he has seen a trolley car equipped with the mercury arc rectifier, in which the energy required was as great as would be required in elevator service and the character of load was certainly as fluctuating.

Mr. Dickinson said he was glad to hear from Mr. Wagoner. He had looked up this mercury arc rectifier a month ago, and in order to check himself just before getting up the paper, he inquired in two offices concerning the amount of current required to maintain the arc, and gained the idea it was 600 watts. He was glad to hear that it is considered possible to run elevators through the means of the mercury arc rectifiers.

E. F. McCabe, Lewiston, Pa., asked whether the practice of using starting resistance is not to regulate the supply of current on the circuits on which the alternating-current elevator motor is used; in other words, is it not put there to keep down fluctuations, and if the starting resistance were eliminated would it not be impossible to use lights on the same circuit with the motors?

W. A. Layman, St. Louis, Mo., replied to this question. He had been endeavoring to introduce a type of motor which he thought Mr. Dickinson had in mind. Resistance has been employed up to date because it was felt that the American central stations would require its use in holding down starting current. The same equipments can be employed without starting resistance, and the starting current can be held down to reasonable dimensions, but they have been endeavoring to secure a type of motor that would develop full load torque with practically full load current, or develop torque at half load, which, as he understood it, is about the worst condition the elevators have to start under, —torque at one-half, and current at one-half—and for that reason starting resistance has been employed. The greatest difficulty in the alternating-current elevator situation, at least one of the greatest difficulties up to date, has been the fact that some of the elevator companies have not recognized that the central station man has anything to do with the question and his wishes as to elevator development have not been considered to any great extent.

President Blood stated that in connection with the offer of prizes by the Cooperative Electrical Development Association, he had some little time ago appointed Messrs. Burnett, Mather and Montague as a committee to examine the papers submitted in the contest. He asked Mr. Burnett to make the report.

Mr. Burnett stated that the committee had examined very carefully the twenty-two papers submitted, and were very much pleased to find that the individual ideas of the three members of the committee were entirely in harmony. He therefore offered the following unanimous report:

"The undersigned committee appointed by President Blood, to judge papers on the subject of 'Organization and Conduct of a New Business Department Suitable for Central Stations in Cities of 50,000 Population and Under,' beg to report as follows:

"First prize, M. S. Seelman, Jr., Brooklyn, N. Y.

"Second prize, S. M. Kennedy, Los Angeles, Cal.

"Third prize, J. M. Robb, Peoria, Ill.

"Honorable mention, C. N. Jackson, Toledo; Fred D. Sampson, Charlotte, N. C.; W. R. Sweaney, Minneapolis; James L. Wiltse, Brooklyn.

"We recommend that in lieu of any combination of these papers they all be published."

The prizes are as follows:

First prize, $500; second prize, $300; third prize, $200.

J. Robert Crouse, with whom this idea originated, said his organization would be glad to follow out the recommendations of the committee, and give the papers which won the prizes and those which have had honorable mention the widest possible distribution.

During the coming year it is their idea to offer other prizes for papers along commercial lines that may be comparable

with the papers which have been submitted. The manufacturers whom he had the honor to represent in connection with this thing, and whose good judgment in reference to the selling effect of a move of this kind is perhaps better than his own, have been unanimous in the belief that the $1,000 spent on these prizes carried possibly a better selling effect than any other $1,000 spent by any manufacturer or group of manufacturers.

S. R. Bradley, Jr., moved that a committee of five be appointed by the president to consider and report to the executive committee upon the relations between the association and such local associations as may exist in the various states or districts. Motion carried.

President Blood appointed as a committee provided for in the motion the following gentlemen: S. R. Bradley, Jr., New York; E. H. Davis, Pa.; L. H. Scherck, Ala.; J. F. Gilchrist, Ill.; W. H. Fellows, Kansas.

The paper on "Modern Switchboard Practice, with Particular Reference to Automatic Devices," by Mr. E. M. Hewlett, was read by the author.

In this paper only representative cases are dealt with, practice varying with individual installations according to the local conditions. It is, of course, understood that no absolute rules can be laid down to govern practice. One general principle is put forward as a basis for laying out a system of control, "make everything just as simple as the operating conditions will economically allow."

In the discussion four representative systems are considered as follows:

Case 1—For villages and small cities, with a simple 2,300-volt, sixty-cycle distribution.

Case 2—For medium-size cities, with 2,300-volt, sixty-cycle distribution.

Case 3—For large cities, with 4,150-2,300-volt, sixty-cycle, four-wire, three-phase distribution.

Case 4—For very large cities, with 6,600 to 13,200-volt, twenty-five to sixty-cycle, underground transmission to substations and direct-current or alternating-current distribution from the substations.

Under Case 1 we have the simplest conditions, which could be well met by the use of plug switches and fuses. The new type of fuse block, known as the "TD," is suitable for such work. Automatic oil switches could also be used on the multiple feeder circuits in place of plug switches and fuses. Instantaneous trip coils would be used, as the extra cost of time-limit relays would not be warranted. The generators are not ordinarily provided with automatic protection. Case 2 represents a large number of systems with slight modification. Under this case overhead lines would probably be used for the circuit, though in some cities there may be a partial underground distribution.

Fuses could be used satisfactorily on systems under this case, but automatic switches allow the circuit to be cut in more quickly and would generally be recommended except on the smaller plants. Under any conditions fuses would be used for protecting the series arc transformers.

Where automatic switches are used on the smaller plants they should have instantaneous trip; in the larger plants inverse time-limit relays would be advisable.

The generator switches would be non-automatic, it being found in practice that more inconvenience arises from automatic protection than from non-automatic switches.

In a plant of, say, 1,500 kilowatts and above, it is good practice to mount the oil switches away from the board, operating the switches by means of suitable levers and cranks.

When the station capacity reaches 3,000 or 4,000 kilowatts it is advisable to place the switches in masonry compartments and in some cases operate the switches electrically.

Under Case 3 a system with a main generating station at the outskirts of the city with an alternating-current-direct-current substation in the business district has been chosen. In a system of this character, automatic oil switches are invariably used on the outgoing circuits and inverse time-limit relays are recommended except for the substation feeders, which should have definite time relays. If automatic switches are provided with the generators, a reverse-current definite time-limit relay is probably the best form of protection. A better arrangement would be, however, to omit the trip coils from the switches and let the relay simply light a lamp or ring a bell.

The incoming lines at the substation should have inverse time relays. This, in combination with the definite time relays in the main station, in case of a short-circuit between stations would open up both of the line switches at the substation and the switch of the short-circuited feeder only in the main station, thereby indicating which feeder was in trouble.

On a severe short-circuit the synchronous machines in the substation would possibly feed back into the short-circuited line before the machine switches could open and cause more current to flow in the short-circuited line than in the other line from the main station. On account of the inverse time element of the line relays, the relay in the short-circuited line would operate more quickly than the relay in the other line, relieving the system. As the relays in the synchronous machines are preferably of the instantaneous type, the above case would not often arise. If three lines were installed from main to substation, the inverse time relays would act selectively on short-circuit and only the short-circuited line switches would open.

On the direct-current side of the rotary converters or motor-generator sets reverse-current relays are usually provided to trip the circuit-breaker of the machine in trouble, leaving the other machines in circuit.

Case 4 represents the largest central stations feeding a number of substations, all distribution to consumers being from the substations, such distribution being either direct or alternating current and sometimes both.

The voltage of this class of systems is from 6,600 to 13,000 volts, and the amount of energy generated is large, making it necessary to use electrically controlled switches, mounting the switches and bus-bars in masonry compartments. The usual practice is to provide two sets of bus-bars, each set being sectionalized at least once. In some cases the machines are all run in parallel on one set of bus-bars, using the second set only for emergency. In other cases some of the generators and feeders are connected to one set and others to the other set. It is obvious that while the best load-factor and efficiency may not be obtained, liability to a complete shutdown is eliminated by the latter method, and in case of a short-circuit there is not so much energy feeding in parallel and consequently less trouble is likely to arise.

As to automatic protection, practice varies somewhat. Either non-automatic switches or automatic switches with reverse-current time-limit relays are used on the generators. On feeders, the bellows type inverse time-limit relay has been used largely with excellent results.

In a system with three or more circuits to each substation, or with only two to each substation, if tie lines are used between stations, selective action can be obtained by the exclusive use of inverse time-limit relays properly adjusted, or with inverse time-limit relays on the substation

end of lines and definite time-limit relays on the generating station end.

With three lines feeding a substation, direct from generating station or partly through another substation, a short-circuit on one line causes the other two lines to feed in multiple into the short-circuited line, giving the latter twice as much current as either of the other lines. The relay of the short-circuited line would operate more quickly than the other relays, opening the circuit and relieving system. The relays at the generating station end, if either of definite time-limit type or if of the inverse type and set for a longer time than the substation relays, will not operate until after the substation relay, and then only the relay of the line in trouble will operate. Especially in the case of a system with considerable synchronous apparatus, the matter of the setting of the relays should be carefully studied and experiments made to determine the proper adjustment.

The generating end of the substation should be treated the same as generating stations under Cases 2 and 3 if alternating current, or if direct current the same as substations discussed under Case 3.

Mr. Wallau thought that the use of time-limit relays held good on large feeders carrying a great amount of energy; with small distributing feeders carrying anywhere from 100 to 300 watts, an automatic switch controlled by an instantaneous relay, which set high enough, so that ordinary variations in load, and which are only liable to come instantaneous and will not trip it, is just as good protection to his mind. For instance, in operating a number of lighting circuits the average load on his company's line was around fifty amperes, reaching perhaps sixty-five to seventy-five maximum, and instantaneous relays are set to drop with ninety amperes in the wire. He has experienced no difficulty in opening the circuit under these conditions, and they do not open at times when they should not.

The paper on "Control of Motors on Electric Light and Power Circuits" was read by H. D. James.

There was no discussion on this paper and the meeting was adjourned until 8.30 o'clock the same evening.

THURSDAY EVENING, JUNE 7.

Mr. T. C. Martin presided as chairman of the evening session and introduced Everett W. Burdett, who presented an address on "The Meaning and Proper Treatment of the Agitation for Municipal Ownership of Public Utilities."

Mr. Burdett described at length the causes leading up to the agitation for municipal ownership and pointed out the failure of those institutions abroad which have been allegedly successful. Remedies are pointed out and a campaign of conciliation and recognition of all reasonable demands by the public on the part of the supplying companies is endorsed. This address will be abstracted very fully in a later number.

Percy Ingalls moved a rising vote of thanks to Mr. Burdett for his very excellent address. This motion was unanimously carried by the entire audience rising.

FRIDAY MORNING, JUNE 8.

President Blood called the meeting to order at 10.20 o'clock. The paper on "Comparison of Direct Current and Induction Motor Load," by L. E. Bogen, was called for, but as Mr. Bogen was not present the next paper on "New Illuminants," by Professor H. E. Clifford, was presented.

Professor Clifford called attention to the new carbon filament lamp with a rated efficiency of 2.5 watts per candle and a life equal to that of the 3.1-watt lamp, which has been developed and placed on the market by the General Electric Company. Tantalum lamps, he said, are now obtainable abroad for voltages from 50 to 110, with an efficiency of 2.2 watts per candle. Osmium lamps with a guaranteed efficiency of 1.5 watts and a life of 500 hours are now for sale in England. The Kusel lamp, also making use of a metallic filament, has shown an efficiency better than one watt, but although it is announced for 110 volts, tests have been published at no higher voltage than thirty-two.

A development of some importance in connection with the Nernst lamp during the past year is the production of a series lamp for street illumination of moderate candle-power, thus permitting the lamps to be used in cases where a fairly large number of small units is required. The several luminous or flaming arc lamps developed by Bremer, Auer, Nernst, Blondel, Whitney and Steinmetz are taken up, and comparisons given showing the characteristics of each of these lamps.

Under the heading of vapor lamps, the characteristics of the Cooper Hewitt mercury vapor lamp and the Moore vacuum tube lighting system are discussed.

The author concludes that the concentration of effort in the securing of higher efficiency tends to make one lose sight of the danger of further increasing the intrinsic brilliancy, a danger all too plainly indicated in some of our modern illuminants. The last word in increased efficiency has not yet been spoken, but even so, the time seems ripe for greater devotion to questions of distribution.

D. McFarlan Moore called attention to his latest form of tube lighting. He suggested that photometric measurements be made of the 187-foot tube which was being used for part of the illumination of the pier. The actual watts per Hefner of this tube, he stated, were 1.18—that is, the efficiency of the tube as a light source. However, if all the transformer and other losses were taken into account, the watts per candle of the tube would be 1.5. The actual candle-power of the tube is 2,200 and the total watts, 3,300. The great problem of electric lighting is to produce a light that is suitable for illuminating large areas and distributing light in a manner comparable with daylight. He said that the tube was producing about 400 per cent more light than the incandescent lamps which it had displaced. He also stated that this tube was burning air electrically, and that as long as there was atmosphere, and as long as current could be furnished, the tube would live without renewal.

Regarding the commercial state of the new system of lighting, he said that thousands of feet of these tubes were in service, and that none had given any trouble; that every foot of tube that had been placed in service was still in use.

Regarding the possibility of breakage, he said that the nature of the system was such that the liability of the tube being broken was extremely small. The fundamental idea is to place the tube out of reach, so that there would be no chance of its being broken. In actual commercial use there had been little trouble on this score.

Concerning the utility of the tube for small units, he agreed that it was not suitable in short lengths, but that in units of about twenty feet it would compete with the ordinary incandescent system in actual use.

As far as the color of the light was concerned, it is possible, by changing the gas which is fed to the tube, to produce any color desired. The efficiency of the light in getting an absolutely white color is cut about in half.

The next paper, "The Higher Efficiency Incandescent Lamps, Their Value and Effect on the Central Station Service," Mr. Francis W. Willcox, was read by the author.

This paper deals with the new General Electric metallized filament lamp. This

lamp gives a mean initial horizontal efficiency of 2.5 watts per candle and a useful life practically the same as the 3.1-watts-per-candle-lamp. The new lamp saves twenty per cent in energy consumed for the same life and candle-power service, and gives twenty-five per cent more candle power for the same energy consumed, and equal lamp and candle-power maintenance. The probable cost of the new lamps will be more than the cost of the present lamps, and for the purpose of the paper the cost of the sixteen or twenty-candle-power metallized filament lamp is taken as twenty cents, as compared with sixteen cents for the present lamp.

Assuming that a central station is supplying free renewals of the present 3.1-watts-per-candle lamp, the consumer could buy his own renewals of the new 2.5-watts-per-candle lamp at twenty-five cents each and save money at all rates above five cents per kilowatt-hour.

With companies selling current by meter, at various rates per candle-power, and limited to the same number and candle-power of lamps supplied and the same hours of use, there would theoretically appear to be somewhat of a reduction in income with the higher efficiency lamp, and a somewhat increased cost of lamp renewals. The author, however, does not expect to see the income reduced, but largely increased.

Where companies are selling by the lamp-hour or flat charges per lamp per month, the new higher efficiency lamps have a distinctly positive value. This value lies in the saving a high efficiency lamp will secure in the station capacity and in generating costs that are strictly proportionate to output.

A. C. Dunham, Hartford, Conn., considered the metallized filament lamp the greatest improvement that has been made in electrical appliances in the last five years. He finds that the two complaints that are most usual among customers are in the first place they can not get enough light for the money they pay. They pay all the money they can afford, but are hungry for light, and do not feel they get all they ought to get for the money they pay. Next to that is the complicated bill. The Hartford company doubled its output in the last ten years, every three and one-half years. This has been done without any solicitors. He believes it has been due entirely to a steady decrease in the cost of light. For instance, since this new system of distributing light, so as to make all light available, has been possible, the increase in the light put out has been much more rapid. The first four months of this year the company increased its output $28,000 and of that about $4,500 a month was light, without anything more than the usual increase in the number of customers. He believed that it was entirely due to the use of the Meridian and such lights as place the light just where it is wanted. There is a very good gas company in Hartford, as well managed as any gas company in the country, but there is practically no competition whatever in the matter of lighting; they sell stoves mostly. The lamp mentioned, say at fifty watts, gives the station as much income as they ever had; and it gives the customer plainly twenty-five per cent more light. He believes that the increase in the value of the output will go on so fast that before this lamp gets down to two watts, the station will not feel that decrease at all. It has one quality which is very valuable. They have been in the habit of taking off their sixteen candle-power lamps every 400 hours, because they blacken. They do not think it pays to give a nominal candle power, and not the real candle power, but this lamp does not blacken. It can be run to the limits of its useful life. Take a twenty candle-power lamp, it goes down to a little below seventeen candle power in 600 hours, and then goes out.

The lamp burns out and a new one is put in its place and the lamp gives seventeen candle power nearly at the close of its life and that looks like an increase of fifty per cent in the life of the lamp, a real increase, which in this business is what is wanted.

The paper, "The Edison System of Southern California," was read by Mr. R. H. Ballard.

As there was no discussion the last paper on "Design and Manufacture of Hydro-Electric Installations," by E. F. Cassel, was abstracted by C. A. Tupper.

The development and perfection of electrical apparatus marks a new departure in hydraulic power requirements, the most important development being long-distance transmission. Every mile added to the practicable distance of transmission of electrical energy either increases the market for an already developed water power or brings into the market one heretofore undeveloped. In a hydraulic installation the water pressure is a fixed physical condition. The minimum amount of water available is also a physical condition which can not be varied at the will of the designer. These essentials being fixed factors in the problem, it follows that to secure the best efficiency and produce the most satisfactory results, equipment must be furnished best suited to these fixed conditions.

In designing a hydraulic installation, the head and quantity of water being known, the size of wheel and number of revolutions best suited for high efficiencies can be determined. If only the hydraulic part of the installation were to be considered this would require little cooperation among the manufacturers of the various parts of the equipment.

To sum up the matter, it appears to the author that the personal interest which the manufacturers of a hydroelectric installation, as a whole, would have in the results actually achieved by the installation when in operation introduces a stronger tendency toward perfection in practice than the present method of manufacturing material in accordance with specifications, but with no responsibility as to whether such specifications may be right or wrong. That this tendency would be in the direction of better practice, and, being so, would receive the hearty cooperation of engineers interested in this branch of engineering, the author believes will be confirmed by all who have given the matter a little thought.

The report of the committee on the president's address was received as follows:

"In order that the matter of annual dues should receive the prompt consideration urged by the president, your committee recommends that a committee be appointed by the incoming president, and approved by the executive committee, to consider this subject which has so much to do with the general welfare of the association, with instructions to report at the next annual meeting so that if its recommendations are approved at that meeting the renewed rates can become immediately effective.

"The recommendations concerning the Class C members have been met by the appointment of a special committee which has already reported at an executive session. We consider these recommendations most timely and advise that they be fully adopted at this convention.

"The arrangement for offices in the new United Engineering Building, Thirty-ninth street, New York city, seems to be well considered and such as should adequately meet the growing requirements of the association of its general office work.

"As to the matter of general relations with the Underwriters, your committee is decidedly of the opinion that in order to best conserve the interests of the members individually and collectively, and in

order to maintain—at all times—the best possible conditions as to the fire hazards of electricity, and also harmonious relations with the Underwriters, we endorse the suggestion that a representative of the association be immediately retained by the association, who shall devote part of his time to the questions arising in this connection.

"The central exhibition idea has been successful this year. It should be continued wherever possible to make satisfactory arrangements.

"The policy, adopted for this convention, of relieving local parties from the necessity of making financial arrangements for the annual meeting, judging by the experience of this meeting, is a wise one."

The report was accepted and referred to the incoming executive committee.

Paul Lupke, editor of the "Question Box" and "Wrinkles," presented the volume, and the introduction was read by John McFeeley, of Newark.

The regular session then adjourned and an executive session was held.

At the executive session the only business transacted was the reception of the report of the committee on nominations.

Electric Light Convention Notes.

THE convention of the National Electric Light Association at Atlantic City last week was notable for the many diversions and interesting elements which entered into the life of the meeting. Atlantic City is famed as a pleasure resort, and in addition to the great value of the technical sessions, the entertainment features were especially enjoyed. The reception at the Marlborough-Blenheim on Tuesday evening was very largely attended and President Blood was kept busy greeting the attendants during the best part of the evening. The chair ride for the ladies on Friday morning was well patronized, and that for the gentlemen in the afternoon was very complete and presented an interesting and at times highly amusing picture, sweeping the board walk, with chairs abreast the full width.

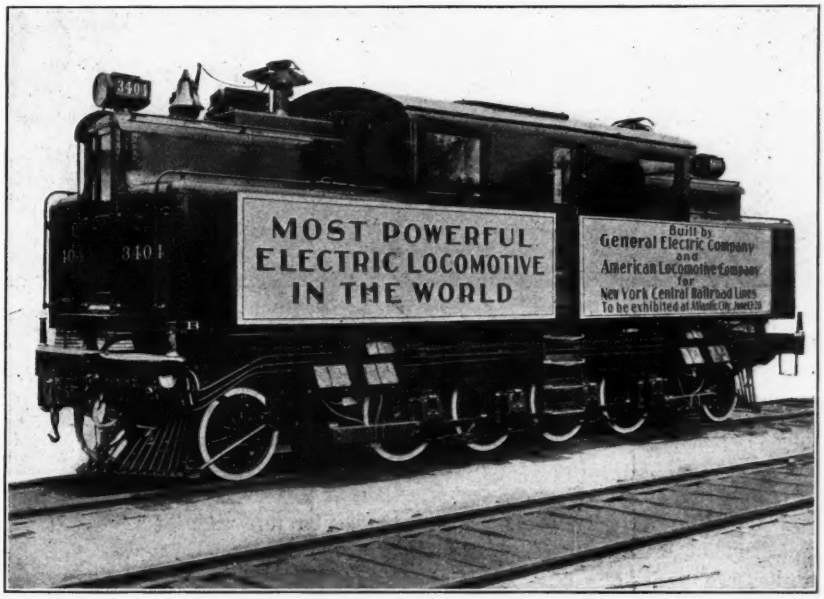
On Thursday a baseball game was scheduled between the eastern and western teams. Mr. John F. Gilchrist was appointed captain of the western team and F. G. Vaughen of the eastern team. By some mishap the players became more or less separated in reaching the ball grounds and part of the baseball aggregation went to Chelsea and the others made up a game on the beach alongside the convention hall. Messenger boys were sent scurrying for baseballs and bats and Van Rensselaer Lansingh, of the Holophane Glass Company, and P. S. Klees, of the Franklin Electric Manufacturing Company, were chosen as captains of the two sides. It was surprising what a splendid article of baseball these two scrub teams put up. The running between the base lines was extremely heavy, due to the deep sand, and it was necessary to move the diamond twice to keep third base from floating off on the surf. The first batted ball took the crown off the hat of E. H. Haughton, of the Bryan-Marsh Company, and the dignified members of the side-lines contingent were forced to dodge very frequently to escape the foul tips which were prevalent during the five innings played. At the end of the fifth inning the game was called on account of high tide. The line-up and score was as follows:

INS.		OUTS.	
P. S. Klees, captain	1b.	V. R. Lansingh, captain,	p.
R. M. Standish	p.	P. R. Stout	c.
Elliott Reynolds	2b.	P. S. Dodd	1b.
E. S. Goldthwaite	3b.	G. O. Curtis	2b.
E. H. Haughton	s. s.	F. D. Hallock	3b.
B. Seltz	c.	A. A. Gray	s.s.
A. D. Page	c.f.	L. G. Shephard	r.f.
E. H. Schwartz	l.f.	M. B. Dowd	c.f.
J. M. Smith	r. f.	I. Sickel	l.f.

Ins.	3	2	0	4	1	—10.
Outs.	0	6	6	2	0	—14.

D. F. Schick acted as score-keeper and C. B. Burleigh, the popular Boston representative of the General Electric Company, acted as umpire. Mr. Burleigh made some awful decisions, and the small boys on the side lines wanted him removed very frequently, but he was so impartial in rooting for both sides that it was very easy to forgive him for calling a strike a ball after the batter has swung himself clear off his feet.

On Friday one of the 100-ton electric locomotives which the General Electric Company and the American Locomotive Company are furnishing for the electrification of the New York Central lines arrived in Atlantic City and was placed upon a side track at the Pennsylvania depot, so that an inspection might be possible by those interested. This is the most powerful electric locomotive in the world. Its capacity under ordinary working conditions is 2,200 horse-power. It is said to be able to develop a speed of eighty miles an hour when in regular operation. It is the same type as the famous "6000," which has so many times distanced its steam competitor while working on the test track of the New York Central road near Schenectady. The locomotive, an illustration of which is given herewith, attracted a great deal of attention, and while it is primarily on the ground as an exhibit for the railway convention, the central station men visited it in numbers. The locomotive will be exhibited during the convention of the Master Car Builders and Railway Master Mechanics, which is



NEW YORK CENTRAL ELECTRIC LOCOMOTIVE AT ATLANTIC CITY, N. J., JUNE 8, 1906.

in session at Atlantic City this week and next.

The accompanying illustration gives a partial idea of the Westinghouse exhibit, which occupied a large space in the exhibition hall on the right hand side of the entrance. Green drop curtains surrounded the booth on all sides and the floor was covered with a matting harmonizing in color. A feature of the exhibit was a large model of a Westinghouse type-C, single-phase wattmeter for 3,000 alternations. The different styles of fans made by the Westinghouse company were supported on the posts surrounding the booth, and overhead a half dozen of the new type Westinghouse ceiling fans were kept in operation. On one side the exhibit was lighted by Nernst lamps and on the other by type K Cooper Hewitt mercury vapor lamps, and there was also a very complete line of Westinghouse arc lamps. The new Nernst series-alternating, vertical-glower system of street lighting attracted a great deal of attention. Enlarged views of important installations of Westinghouse apparatus were shown by means of a large revolving photograph holder. The Westinghouse company occupied thirty rooms at the Marlborough-Blenheim and had headquarters on the first floor. The company's publishing department prepared for distribution from the Westinghouse booth, and also from the Westinghouse headquarters in the Marlborough-Blenheim, an album entitled "Westinghouse Views." This showed the works and installations of the different companies. The exhibit was in charge of Mr. J. C. McQuiston, superintendent of the Westinghouse Companies' Publishing Department. S. P. Wilbur, of the Nernst Lamp Company, and E. D. Hays, of the Cooper Hewitt Electric Company, represented their respective companies at the exhibit.

The exhibit of advertising literature was very attractively laid out, that of the New York Edison Company occupying a large corner of the exhibition hall. This advertising literature, many samples of which have been reproduced in the ELECTRICAL REVIEW, attracted a great deal of attention, and the central station managers took away with them a great variety of folders, booklets, circulars, return cards and novelties. The New York Edison Company's exhibit was in charge of Mr. Cyril Nast, who is to be complimented on his very efficient work. The exhibit from the Philadelphia Electric Company was very attractive, and that from the Edison Electric Illuminating Company of Brooklyn also came in for a great deal of praise. Other central station companies showing a very attractive line of advertising literature were the Denver Gas and Electric Company, Denver, Col.; the United Electric Light and Power Company, New York city; the Edison Electric Illuminating Company of Boston, and the Public Service Corporation of New Jersey.

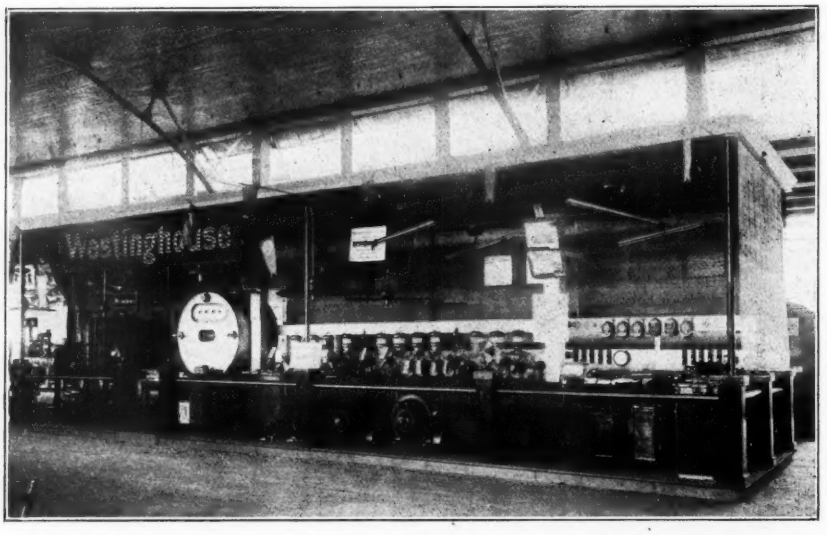


EXHIBIT OF THE WESTINGHOUSE COMPANIES, NATIONAL ELECTRIC LIGHT ASSOCIATION CONVENTION, YOUNG'S PIER, ATLANTIC CITY, N. J., JUNE 5-8.

Probably one of the elemental factors in the success of this convention was the very careful work of preparation which was undertaken by the convention committee, headed by Arthur Williams. Through the courtesy of the New York Edison Company a large staff of employés was constantly at hand at the convention headquarters attending to the registration of attendants and guests, looking after the distribution of the papers at each session, superintending the printing of the register of delegates and assisting the secretary, W. C. L. Eglin, and the assistant secretary, Miss Harriet Billings.

The efforts of George F. Porter, master of transportation, were also warmly appreciated, and Mr. Porter is entitled to a great deal of the credit for bringing out so large a representation of delegates and guests.

The manufacturers were particularly well represented at this convention and in addition to those making exhibits there was a large corps of representatives present from all over the country. Among those in evidence were the following:

S. A. Douglass and C. C. Baird, representing the H. B. Camp Company and the American Vitrified Conduit Company.

Ray D. Lillibridge, New York city.

R. T. E. Lozier, Power and Mining Machinery Company, of Cudahy, Wis.

Max Loewenthal, New York city, exhibited the "X-L" socket clamp. This clamp holds the key of a lamp socket in the on position, so as to prevent any one from turning it off in case a heating device consuming more than three amperes is connected to the socket.

H. B. Kirkland, general sales manager, R. B. Corey, H. C. Adams and Alexander Henderson represented the American Circular Loom Company. A complete line of "Lutz" metal moulding fittings was shown. This includes regular and irregular angles, special fittings for connection with conduit systems, outlet boxes, receptacles and rosettes. The "Lutz" metal moulding is intended for exposed wiring, and is designed to give a superior form of material for the canalization of circuits. The company exhibited also the American Circular Loom tubing and "Electroduct" enameled conduit.

Mr. Basil G. Kodjbanoff, manager of the Benjamin Electric Manufacturing Company, was very much in evidence, and was kept busy talking about the quality and utility of the Benjamin specialties.

H. G. Steele represented the Pittsburg Transformer Company, which exhibited a full line of "Pittsburg" lighting transformers.

A. A. Serva, general sales manager, and T. L. Sturgeon, manager of the Philadelphia office; J. C. Lott, W. C. Knight, C. A. Woolsey, E. H. Porter, J. A. Strauss and J. H. B. Van Zandt represented the Fort Wayne Electric Works. These gentlemen were assisted by J. C. Moulton,

S. A. Ochs, A. H. Boyd, S. S. Rothrock and Gentry Shelton.

Mr. Cyrus O. Baker, of New York, former master of transportation of the association, was unable to be present at Atlantic City. He was missed by a large circle of friends.

The Switchboard Equipment Company, Bethlehem, Pa., was represented by R. A. Badeau.

J. Franklin Stevens, president of the Keystone Electrical Instrument Company, Philadelphia, Pa., brought to the attention of central station men a new line of portable ammeters and voltmeters of the shielded type. A particularly compact instrument is the combination voltmeter and ammeter, with two distinct scales. A new alternating-current instrument was shown and various arrangements of shunts and shunt-boxes.

The Safety Insulated Wire and Cable Company, New York and Bayonne, was represented by Avery P. Eckert, sales manager, and James Ferguson, superintendent of the plant. This company had a comprehensive exhibit of all the modern types of wires and cables, and much other interesting data in the way of accomplishments in this line of manufacture.

The Atlantic Insulated Wire and Cable Company was represented by George F. Porter, who, in addition to ably conducting the affairs of the association as master of transportation, found time to meet many customers of his company.

The Okonite Company, Limited, of New York, distributed post cards carrying an illustration in the shape of a strong man wearing the Okonite trade-mark, whose body was composed of different cables and wires manufactured by the Okonite Company. The caption beneath this striking figure was "Able to Carry Your Overload —Try Me." Captain W. L. Candee and Romaine Mace saw that the cards were well distributed.

Mr. Chas. R. Huntley, vice-president and general manager of the Buffalo General Electric Company, was warmly welcomed by a host of friends. Mr. Huntley, who is an ex-president of the association, was elected a member of the executive committee.

Mr. N. F. Brady, vice-president of the New York Edison Company, attended the last two days of the convention and took a deep interest in the proceedings.

Mr. J. R. Lovejoy, of the General Electric Company, Schenectady, N. Y., was present during the last two days of the convention. Mr. F. H. Gale, of the same company, who had charge of the exhibition features, was present during the entire week, and is also looking after the exhibition of his company for the railroad convention this week.

Dr. W. M. Habirshaw, president of the India Rubber and Gutta Percha Insulating Company, made his headquarters at the Hotel Traymore, and was greeted by a host of friends. Mr. J. B. Olson, of the same company, and Mrs. Olson were also in attendance throughout the convention.

Mr. R. P. Tell, of Milwaukee, vice-president of the National Brake and Electric Company, and Mr. S. I. Wailes, manager of sales of the same company, with headquarters at Chicago, were in attendance at their booth on the pier, Mr. Wailes remaining throughout the convention. They report an unusually busy season for their company, their motor department being particularly rushed with orders at the present time.

Mr. N. C. Cotabish, sales manager of the National Carbon Company, Cleveland, Ohio, and Mrs. Cotabish were present. The electric light companies of the United States are very large patrons of the National, and Mr. Cotabish and Mr. D. D. Dickey, the treasurer of the company, were kept quite busy greeting friends and customers on all sides.

Professor Louis B. Marks, the well-known inventor and illuminating engineer, was in attendance throughout the convention, making his headquarters at the Hotel Chalfonte.

Mr. George W. Vallee, Atlantic City, whose electric signs were greatly in evidence, was a constant attendant at the sessions of the convention. Mr. Vallee is making a specialty of electric signs, and his work is developing the use of this method of advertising among the patrons of the lighting companies quite generally.

Mr. C. E. Corrigan, of the Osburn Flexible Conduit Company and the National Metal Molding Company, is one of the regular attendants at the conventions of this association, and on this occasion found many users of his excellent product present, all of whom were pleased to meet in him the active head of the interests manufacturing these products which enter so largely into the use of electric wires and cables.

Mr. Alfred F. Moore, the well-known wire and cable manufacturer, of Philadelphia, had an attractive booth on the pier which at times was the headquarters of many of the wire manufacturers, Mr. H. L. Shippy, of the John A. Roebling's Sons Company, and others visiting with him.

Mr. Chas. B. Price, treasurer and general manager of the Pettingell-Andrews Company, of Boston, Mass., spent several days at Atlantic City attending the convention.

One of the interesting events of the convention week at Atlantic City was the dinner, or rather supper as it was served at 9.30, of the Order of the Sons of Jove, which occurred at the Hotel Shelburne. The grill room on the beach floor had been especially decorated and prepared for the gathering. The supper was served at individual tables and the surroundings were made most effective. Between two hundred and three hundred gentlemen enjoyed the collation, all of whom were either members of the organization or those about to be proposed and initiated. After coffee, adjournment was taken to one of the assembly rooms, where Mr. H. B. Kirkland presided with grace and dignity, and here addresses were made by Messrs. Bailey Whipple, of Pittsburg; C. E. Corrigan, New York; Stephen H. Goddard, New York; C. B. Burleigh, Boston; Louis Cassier, New York, and J. B. Campbell, New York. Following this fifty or sixty new members were accepted into the fold.

This organization was originally started in Texas. The underlying principles and intent of the society is better fellowship among the men of the electrical industry. As indicated by the interest taken in the movement to materially broaden and enlarge the scope of the organization, many men identified with the largest interests in the electrical industry were present. A few of those were: Messrs. H. L. Shippy, R. B. Corey, John Dale, Elliott Reynolds, Harry H. Van Staagen, Harry C. Rice, Philip S. Dodd, Charles W. Price, Hon. W. E. Phelps, S. G. Meek, George R. Carr, J. M. Smith, A. A. Serva, S. A. Ochs, Alexander Henderson, W. S. Sisson, A. H. Abell, S. A. Douglass, C. C. Baird, C. H. Johnston, J. B. Olson, Albert Mann, Hon. T. H. Brady, J. W. Brooks, P. S. Klees, C. N. Thorpe, G. O. Curtis and others.

The "Electrical Review" and the "Atlantic Monthly."

The editorial page of the *New York Sun* of June 7 contained the following gracious item, reprinted from the *Providence Journal:*

Every well appointed barber shop now boasts of the daily papers, the "comic" periodicals and the illustrated magazines, while in not a few affected by citizens of refined tastes and managed by barbers of advanced acquirements the *Atlantic Monthly* and ELECTRICAL REVIEW may be found. It is held, therefore, that the barber shop has had more to do with the education of the general public—persons too old to attend night schools—than has the library, either stationary or circulating.

Illuminating Engineering Society.

A meeting of the Illuminating Engineering Society was held at the Edison Auditorium, New York city, Friday evening, June 8, to hear and discuss a paper presented by Dr. Louis Bell entitled "Some Physiological Factors in Illumination and Photometry," an abstract of which will be found on another page of this issue. In the absence of the author, the paper was read by Dr. Clayton H. Sharp.

The discussion was opened by Dr. Percy Friedenberg, who thought the effect of contraction of the pupil of the eye, due to more intense illumination had been overstated, as the field of distinct vision is but a small part of the whole. Contrasts must not be great if the illumination is to be comfortable. The intensity of the light is more important than the quality from a pathological point. The question is: What light will give sufficient illumination without too great intensity? In what way should the illumination be distributed to get the maximum effect with the least wear and tear? One point in the use of incandescent lamps should be noted. They are at times placed close to the eyes of the user and the heat given off is injurious. Open flames are not used in this way. Most public places are too brilliantly lighted. The source of light should be concealed as far as possible and each situation should be given special study. Dark objects and rooms should have more light than light ones, and a ballroom more diffused light than a reading-room. The background should not cause great contrast; much attention should be given to its color, a neutral tint, such as grey being best.

Dr. M. J. Hepburn said the main question is the intensity of the light. In general, the object in lighting seems to be to get an intense illumination. He has found that a subdued light gives the best results and insures the least irritation. The color of the background is important.

Dr. W. S. Dennett believes that it is difficult to get too much light. The main thing is to have light enough and to have it steady. Working with a brilliant light but with a dark background is bad.

W. D'A. Ryan does not accept the view that a low intensity of illumination is the best and called attention to the tendency to use more light, particularly where color values are to be determined. The point has not yet been reached where we need fear we have too much light. Monochromatic light, while it may be easy to work in, may, if used to the exclusion of all other light render the eye blind to other colors. It is important to screen the worker from the heat of the lamp as well as from the direct light. The general tendency is toward diffused light, the intrinsic brilliancy is no longer the chief feature of a lamp.

Mr. J. R. Cravath agreed with Dr. Bell that an illumination of one or two foot-candles is sufficient for ordinary reading, but did not agree with him in thinking that there is danger of providing too great intensity. It is better to light the entire room moderately, than to concentrate all the light on the work.

Dr. Sharp called attention to Dr. Bell's statement that extinction methods are not satisfactory for comparing lights of different color, a statement with which he agrees. The method is not reliable then.

Mr. E. L. Elliott said that in general, as long as we have plenty of light and are comfortable, we need not fear it is too much. But it is possible to get too much. While a brilliant lamp should be placed high, it does not follow that all lamps should be overhead. It is less fatiguing to have the light fall at an angle than vertical.

Mr. V. R. Lansingh said that the United States government has adopted a standard of six square inches per candle power for the intrinsic brilliancy, which is much lower than is ordinarily used.

At a meeting of the council of the society on June 8, it was decided that in order to distribute as equitably as possible the benefits and privileges of membership in the society, the organization of sections is authorized in any city or locality where the local membership is at least fifty. And the membership of New York city and vicinity will be organized as a section.

Each section organized shall nominate and elect for the local conduct of the section, a chairman, two vice-chairmen and a secretary. The expenses of sections incurred for postal card notices and stenographic report of discussions will be paid from the general fund of the society. Expenses other than these must first be authorized by the council.

Programme for the English Trip of American Engineers.

The Institution of Electrical Engineers, of Great Britain, has arranged a programme to be followed during the visit of kindred institutions to England during July and August. Headquarters will be established at the Hotel Cecil, London, and will be opened on June 23 and 24 for the registration of members and guests.

On Monday, June 25, the party will take a special train to Teddington to attend the opening of the new electrotechnical laboratories of the National Physical Laboratory. In the evening a reception and banquet will be given to the guests at the Hotel Cecil by the Institution of Electrical Engineers.

On Tuesday, June 26, the guests will be divided into five groups, which will visit, respectively, (1) the general post office telegraphs and telephones; the London Wall exchange of the National Telephone Company; (2) the Greenwich generating station of the London County Council; (3) the Bow generating station of the Charing Cross, City & West End Electricity Supply Company; (4) the Lot's road, Chelsea, power station of the Underground Electric Railways Company; (5) the Shepherd's Bush power station of the Central London Railway Company. Special tram-cars or automobiles will convey each party to its destination. In the evening a reception and conversazione will be held by the president, president-elect and the council of the institution at the Natural History Museum, South Kensington.

On Wednesday, June 27, there will be an excursion to Windsor.

On Thursday, June 28, a special train will carry the visitors to Rugby, where the works of the British Thomson-Houston Company and Willans & Robinson will be inspected; and to Birmingham, where a number of industrial works will be inspected. In the afternoon the works of the General Electric Company at Witton will be visited. In the evening the lord mayor of Birmingham will hold a reception.

There is an alternative excursion for this day, which includes a visit to Stratford-on-Avon.

On June 29 Manchester will be visited, where the works of the British Westinghouse Electric and Manufacturing Company, Limited, at Trafford Park, and the electrical equipment at Docks No. 9 and Pomona of the Ship Canal Works, will be inspected. In the evening a reception will be held at Victoria University, Manchester.

Saturday, June 30, includes a trip to Liverpool, where various electrical installations will be visited.

On Sunday, July 1, the party leaves for Glasgow. Monday, July 2, and Tuesday, July 3, will be given up to visits to points of interest in the city.

On Wednesday, July 4, Edinburgh will be visited, and on Thursday, July 5, Newcastle-on-the-Tyne.

On Friday, July 6, there will be a visit to Leeds, when the electrical interests there will be inspected, and on the following day, July 7, the party will return to London.

Mr. Arthur Williams, President of the National Electric Light Association.

One of the most popular selections for president of the National Electric Light Association has been made in the case of Arthur Williams, who has been chosen as chief executive of this prominent organization of central station men for the year 1906-1907. Mr. Williams exemplifies that spirit of enterprise which characterizes the more than ordinarily successful business man of to-day. While he is a disciplinarian of the strictest type, and is most methodical in his organization, still his disposition is so genial that he has the entire admiration and affection of the large corps of associates and employés with whom he comes in contact in the great corporation with which he is identified. Throughout the entire electrical field a host of friends will be glad to hail him as president of the National Electric Light Association, an office to which he has very properly aspired through various grades of association in the organization, and which comes as a reward for work ably and intelligently done.

ARTHUR WILLIAMS, PRESIDENT, NATIONAL ELECTRIC LIGHT ASSOCIATION.

Arthur Williams was born on August 14, 1868, and received his early education in public and private schools in Brooklyn, N. Y., and Hartford, Ct. He entered the service of the New York Edison Company in February, 1885, as an assistant in the chemical meter department. In 1887 he was made superintendent of interior construction. In 1887 or 1888, when the company was operating the Pearl street station, he was made electrician of the company, and later on in 1888 he was made superintendent of the third district. In 1889 he became superintendent of the underground department, and during 1890 or 1891 he became general inspector. In 1893 he was made general agent, and has exercised the functions of both the general inspector's and general agent's departments since that time. In addition to his association with the New York Edison Company, he became vice-president of the Yonkers Electric Light and Power Company in 1906. On June 23, 1897, he was elected as an associate member of the American Institute of Electrical Engineers. He was president of the New York Electrical Society, 1901-1902. Mr. Williams was second vice-president of the National Electric Light Association for the year 1904-1905. He was first vice-president, 1905-1906, and was elected president on June 8 last.

Mr. Williams is a member of the Brooklyn Riding and Driving Club, the Yonkers City Club, National Arts Club, Municipal Art Society, Electrical Club, of New York, and the Union League Club, of Brooklyn.

What Constitutes Good Advertising?

In the current issue of a unique publication issued in connection with the work of the Cooperative Electric Development Association, certain strictures appeared in the way of a criticism of the advertising methods of an electric light company in Indiana which recently completed its new plant, which plant possessed an immense smokestack 200 feet in height. The company had paid a venturesome young couple the sum of $200 to have their wedding ceremony performed on the top of this lofty pinnacle. The comments of the publication in question were to the effect that such freak methods might gain notoriety but were never of real advertising value.

In these days of advanced publishing methods an editor may never realize how far down the corridors of time a written word may carry, and in this case criticism found a resting-place, especially as the management of this company is of a most progressive and broad character.

The progress of this company during the past few years has been notable, and its advertising methods and policies of enlarging its business have been most successful and unique. The smokestack marriage was an incident which created more than a ripple of cheerful amusement and was a means of focusing the eyes and minds of thousands of people on the company's progress.

In a talk with General Manager Wm. B. McDonald, of the Evansville Gas and Electric Light Company, Evansville, Ind., it was evident that a clear knowledge of the value of good advertising existed in the management of this company, and that their methods, on the whole, had been most successfully demonstrated.

THE SELF-SYNCHRONIZING OF ALTERNATORS.[1]

BY MORGAN BROOKS AND M. K. AKERS.

The dexterity required for successfully connecting in parallel two synchronous machines, and the apprehension that is felt by the operator lest disaster result from the slightest inaccuracy of manipulation, suggested a study of methods of synchronizing in the hope of diminishing the hazard involved.

When two alternators are controlled as to speed and excitation preparatory to closing the switch between them, it may not be possible to adjust the speed with sufficient exactness to allow reasonable time for closing the paralleling switch at the proper instant. If the switch be closed at or very close to the zero phase-position, and there be no appreciable speed-difference between the machines, no disturbance of the system is caused. A moderate speed-difference is not serious, provided it is possible to close the switch at the proper moment, and automatic arrangements for so closing the switch have been devised. When there is a phase-difference the existing vector-difference in voltage is short-circuited through the two machines. The short-circuit caused by closing the switch offers momentarily less impedance than the sum of the synchronous impedances of the two machines, because the resultant voltage can not be in proper phase relation with the magnetic induction of both machines, and may not be with that of either. There will be an impulsive rush of current greater than one would be led to expect from dividing the vector-difference voltage by the synchronous impedances of the two machines.

The actual momentary current is governed by the resistance and the reactance of the armature windings considered as inductance without iron core, rather than by the synchronous impedance as ordinarily measured. The iron core has not time to become magnetized and to react against the applied voltage before great damage may have been done with even a moderate phase-difference. With large machines whose resistance and pure or non-iron reactance is relatively low, damage by even slightly inaccurate synchronizing will be more probable, as well as more costly, than with small machines, since the impulsive rush of current is proportionately greater. A moderate phase-difference such as ten degrees may be dangerous. If ten degrees (in either direction) be taken as the limit of safety, in closing the switch at random the chances will be seventeen out of eighteen that damage will be done.

We propose to eliminate this great chance for damage by making it safe to close the paralleling switch at any time, regardless of equality of speed or of excitation. It is evident that the maximum circulating current may be reduced in any desired degree by the insertion of sufficient impedance between the machines to be synchronized. It is equally evident that the synchronizing power, or force tending to keep the alternators in step, will be affected; and it remained for experiment to show that it is possible satisfactorily to limit the current, while retaining sufficient synchronizing power. No compelling force exists so long as phase-equality is maintained, and for small angles the force may be assumed to be proportional to the phase-difference.

Steinmetz has shown that the synchronizing power of the current that may circulate between two machines in parallel under the normal condition of equal voltage depends upon the lagging of the current due to the inductance of the short-circuit path through the armatures of the alternators. To retain this lagging current and its desirable effect the impedance to be connected in series between the machines should be highly inductive. We tried various inductances such as transformer coils and arc-lamp regulators, but with indifferent success. If enough inductance was used to prevent too great an impulsive rush of current, the synchronizing current desirable at slight phase-differences was too weak. If the inductance was adjusted to get fair synchronizing power, it was not safe to throw the switch at a very much greater angle of phase-difference than without it. The range of safe angle was, however, perhaps doubled.

We next tried pure resistance, resulting, as might be expected, in loss of synchronizing power, since the circulating current did not have the required lag. The use of condensers in series confirmed the theory above outlined; for the alternators now assumed the 180-degree phase-relation, and retained it with such persistence as to suggest easy synchronizing by using a reversing switch to connect the machines together in the zero phase-relation. At this point we proved by experiment that it was a simple matter to synchronize two alternators through the armature of a third alternator not running, and then by bringing this third machine up to synchronous speed to observe that it automatically fell into step, forming a delta-connected, three-phase system. The oscillograph showed that with equal excitation the electromotive-force curves were properly spaced in 120-degree positions, and that by varying the excitation it was easy to obtain a distorted delta of any desired shape, within reasonable limits, giving a simple means for obtaining any required vector-difference of voltage or current, especially if one of the machines were a polyphase machine but used as a single-phaser in a delta arrangement. The connection was fairly stiff, it being possible to cut off the driving power from two of the machines, when they became alternating motors and carried their previous driving motors as load. The oscillograph showed that the experiment was successfully performed.

Having control of the synchronizing angle at the 180-degree and the 120-degree positions we felt that some way to secure the desired zero-degree angle must be available. A final idea of trying an inductance without any iron core came opportunely. This would secure the desired lagging current, and the pure inductance acting instantaneously would not permit an impulsive rush of dangerous value, even at maximum difference of phase. A trial met with flattering success; and by adjusting the amount of inductance we found that for a 7.5-kilowatt machine a value limiting the maximum current to about half its full-load amperes seemed the best, having due regard to objectionable reaction upon the system, as well as to synchronizing effect.

The experiments were tried at sixty-cycle frequency, and the results were all that could be desired. We could close the switch paralleling two machines, while the machine to be brought into step was at a standstill, and then with approximate excitation it could be started and on reaching synchronous speed it would automatically fall into step smoothly, and with unexpected force, when the excitation could be adjusted and the inductance cut out.

It might be noted here that the circulating current between two machines connected together directly, and with a difference of phase-relation, is by no means equal to the current that would momentarily flow if the machines were switched together at the same vector-difference; that is, there is not the danger to the machinery in having two alternators pull apart, that there is in throwing them together with a large phase-angle. The

[1] A paper presented at the twenty-third annual convention of the American Institute of Electrical Engineers, Milwaukee, Wis., May 28-31.

almost non-inductive character of the synchronous impedance of two large alternators at the first moment of closing the switch is the critical point of synchronizing.

In the case of a synchronous converter, started from the direct-current side, the use of coreless inductance to permit the closing of the connecting switch at any instant is found to introduce a difficulty not present when the converter is otherwise started. This is the occasional tendency of the converter to race as a direct-current motor, owing to the weakening of its field and consequent increase of armature current. This objectionable tendency is easily overcome by the use of a second inductance connected in series with the direct-current armature and additional to the starting box. This inductance should be with iron core, and it will act to prevent the rush of current due to any weakening of the field. This effect need be only momentary, as the converter does not tend to race, once forced into proper phase-relation. We found it desirable to have the speed of the converter brought into step slightly below synchronous speed, or at least not greater, when random closing of the switch was uniformly successful, as with synchronous generators. As this condition is a perfectly normal condition of operation it adds no complication. It may be stated that when synchronizing by means of condensers with the 180-degree phase-relation, there is no tendency for a converter to race with any reasonable difference of speed either above or below synchronism.

We believe the coreless inductance method of synchronizing particularly applicable to synchronous frequency converters, although we have had no opportunity of testing it. The inductances should be arranged for connection in series with both frequencies. Using a large inductance, or purposely regulating the speed so that the synchronizing power is not quite strong enough to enforce falling into step at either frequency alone, the combined synchronizing power of both sides will exert enough force to draw the machines into step promptly and with certainty. The customary slipping of one or more poles would not require positive manipulation of any kind. Some adjustment might be necessary to attain the best results.

We would not wish it understood that in using coreless inductances for safe synchronizing of alternators we recommend closing the switch at random. If the operator closes the switch as heretofore at approximately the moment of least disturbance, a refinement of operation will result. The operator will know that any error of judgment will at worst cause an almost imperceptible disturbance of the system, instead of a possible disaster. A considerable difference in the excitation of two machines will not interfere in any way, since the voltage can be adjusted after synchronizing. Relieved from all anxiety, the operator will work more easily, and score a higher average of perfect manipulations. Less time is needed and the use of a synchroscope is not required, the indications of the lamp being quite accurate enough. The proposed inductance may be connected either in the primary or in the secondary circuits of alternators as desired, and while its value in henries is different, the weight of wire in the coils would be approximately the same in either case; just as in a transformer the weights of primary and secondary windings are nearly equal.

The cost of a suitable coreless inductance is surprisingly small, since a high-current density may be employed, the heating effect is so evanescent. It is impossible for the machines to maintain a sensible vector-difference under normal conditions. Our tests indicate that a flat coil of large diameter for self-synchronizing need not cost more than one per cent of the value of the machine to be synchronized, and one coil might be sufficient for an entire station. Considering the advantages of its use, the cost of such an arrangement is negligible. The inductance for use in the direct-current side of a converter to be synchronized is of the same order as for the alternating-current side, but it is not quite safe to predict its proper value.

Our experiments have been made with equal success upon various types of converters and alternators, including the inductor type. Dissimilarity of wave-form entails no difficulties. A certain hunting action that was always present with regular synchronizing in one series of tests was entirely absent with the new method. It is decidedly easier to connect in parallel two alternators by means of coreless inductance in series, than it is in direct-current operation to connect a second generator to the bus-bars. Our experiments have introduced the inductance in one phase only, although it evidently might be used in all phases, should such method offer any advantage. The behavior of alternators as exhibited in the oscillograph curves while self-synchronizing is beautiful to observe, and we regret that the recent success of the process prevents us from presenting photographic records of the curves at this meeting.

NOTES ON THE LIGHTING OF CHURCHES.[1]

BY EDWIN R. WEEKS.

Next to the acoustics there is no feature of church architecture of greater importance than that of lighting. An inadequate system of lighting is not only an extravagance, but it practically eliminates the beauty and effectiveness of capital, entablature and vaulted roof. The proverbial "dim religious light" of ecclesiastical structures is due to several causes. Architectural limitations produce an unequal and, at times, insufficient distribution even of daylight, and the immense distances through vaulted dome and transept make uniform artificial lighting by the old methods of suspension practically impossible. Again, the immemorial custom of using sombre woods and gloomy wall tints adds to the difficulties.

The chief requisites in church lighting are adequacy and uniformity. The maximum variation throughout the auditorium should not exceed twenty per cent. This uniformity is seldom secured with daylight, but there is no reason why it should not be secured with artificial light, since electricity can easily be transmitted to all parts of the building and practically moulded to suit the demands of distribution, as well as the needs of the architecture and decoration.

The amount of light in the reading plane should not be less than two candle feet—that is, about twice the light required by the average person for reading without the impairment of sight.

A well-planned layout of switch control effects a great economy in any installation. This is especially true in a building containing an assembly room and using a large number of lights.

There are two general systems of interior lighting—the indirect and the direct. In the indirect system the lamps are entirely concealed from view and their light is distributed by means of reflecting or diffusing surfaces. The installation of this system is costly, uniform distribution is difficult, and as about only fifty per cent of the incident light is utilized, the system is wasteful. In the direct system the lamps are so placed that although they may be seen, they are not in the usual line of vision. The installation by this method is less costly, and its operation much less wasteful, since nearly all of the light emitted does useful work. It also facilitates uniform distribution and lends itself more readily to decorative effects and the expression of symbolism.

[1] Abstract of a paper read before the American Institute of Electrical Engineers, Milwaukee, May 31.

The West Allis Plant of the Allis-Chalmers Company.

FOREMOST among the industrial interests which are centered at Milwaukee, Wis., are the plants of the Allis-Chalmers Company, three in number. They are the "Reliance Works," the shops from which Reynolds Corliss engines were for years produced, and where the company's head offices are now located; the South Foundry and the newer works at West Allis, a suburb of Milwaukee, to which extensions now being completed will add more than double the present capacity.

The Allis-Chalmers Company controls and operates altogether seven different plants with an aggregate floor space of seventy-two and one-half acres. The total floor space contained in the three Milwaukee plants alone approximates 48.4 acres, to which the extended West Allis works contribute 31.8 acres. The following statistics show the distribution of floor space of the various buildings of the present and extended buildings of this plant, which is by far the most important of the group:

WEST ALLIS WORKS.

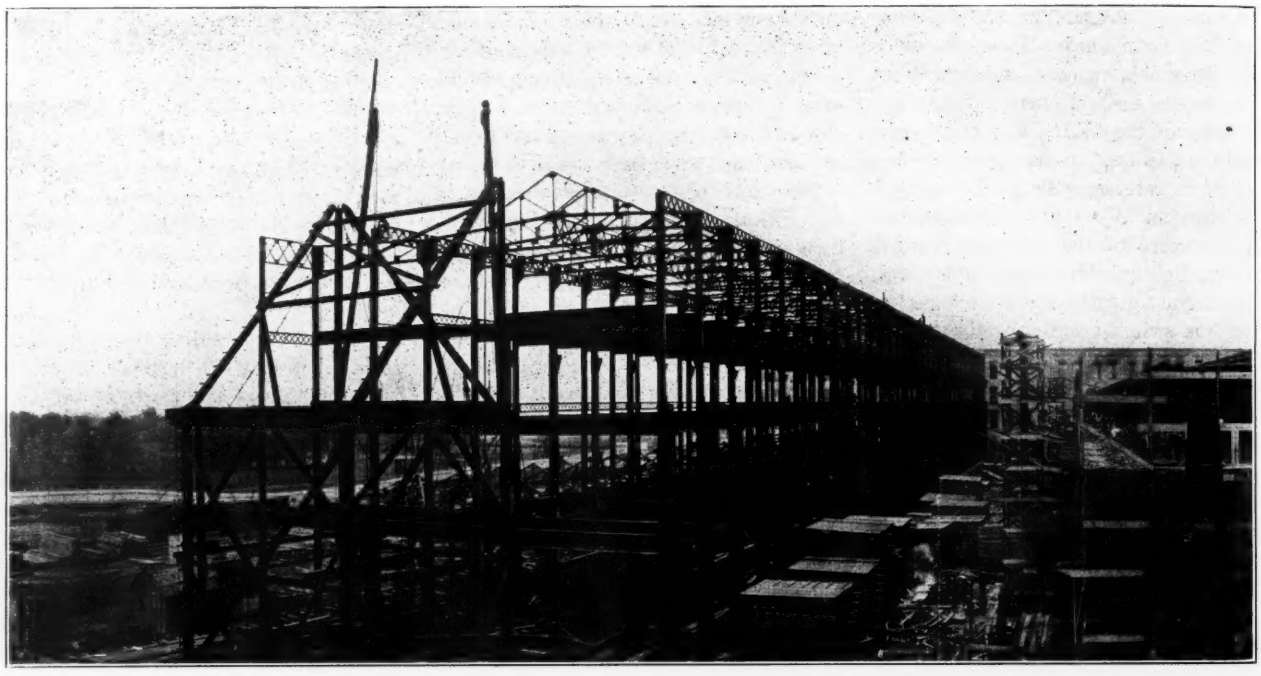
Building	Square Feet Floor Space Old	Extensions	Total
Machine shop No. 1	95,174	.....	95,174
" " " 2	95,627	.....	95,627
Blacksmith shop	50,047	.....	50,047
Storerooms	20,017	.....	20,017
Erecting shop	63,165	65,841	129,005
Engine room	17,502	.....	17,502
Boiler room	8,412	.....	8,412
Foundry	142,089	106,180	249,269
Pattern shop	30,380	22,985	53,365
" storage	139,252	107,216	246,468
Miscellaneous	17,847	4,412	22,259
Machine shop No. 4	.....	132,506	132,506
" " " 5	.....	132,506	132,506
" " " 6	.....	149,162	149,162
	667,959	720,808	1,388,767 sq. ft. = 31.8 acres

The extended West Allis works, when completed, will be capable of affording employment to approximately 11,000 persons, placing this plant among the largest industrial works of its kind in the country. The additions made to an already huge plant, which more than double the former capacity, were necessitated by the rapid development in the company's steam turbine, gas engine and hydraulic turbine business, as well as by the steady increase in sales of Reynolds Corliss engines and the company's older established lines of machinery.

The West Allis site, situated in the town of West Allis, on the outskirts of Milwaukee, has a frontage of 1,575 feet and runs 2,696 feet, or more than half a mile, giving nearly four and a quarter million square feet of ground space or about 100 acres adjoining the tracks of the Chicago, Milwaukee & St. Paul Railway.

The general plan of the West Allis works provides for two sets of building units, one composed of those in which the work is common to every class of product, like pattern shops and storage, erecting shops and foundry; the other group comprising the machine shops where specialized work is done. The two groups of buildings lie at right angles to each other; those of general utility, lengthwise of the plat, north and south, while the machine shops, six units in all, run crosswise of the plant, adjoining the erecting shop at the east end. Facing the ends of the machine shop, units Nos. 1 and 6, stands the foundry with its extensions, running north and south. The pattern storage and pattern shops stand farthest westward in the group and parallel to the foundry.

The extensions to the erecting shop, foundry and pattern shops are duplications of the existing units in practically every detail of construction. The new machine shops Nos. 4, 5 and 6, follow, in general, the construction of the units of the original plant Nos. 1, 2 and 3, each being adapted, however, especially for the kind of work which will be performed there.



PANORAMIC VIEW OF ALLIS-CHALMERS COMPANY'S WEST ALLIS

Units Nos. 4 and 5 will be devoted to the manufacture of steam turbines, turbo-generators and gas engines, while unit No. 6 will be equipped for the manufacture of auxiliary electrical apparatus, winding rooms, etc.

An addition made to the products now manufactured at the West Allis works is the result of a recent acquisition of the sole license to build and sell the well-known Christensen air brake for railway and traction purposes, which has been acquired by the Allis-Chalmers Company. The manufacture of air brakes is an entirely new departure for this company, which will materially strengthen the position now held by it with respect to the equipment of complete railway systems, irrespective of the power used.

The machine equipment for works of the size of those at West Allis, to handle

a product so diversified, is a model of completeness in every way and possesses many features which are new and of interest to the student of shop appliances.

The works power-house will be moved from the present position in the west end of unit No. 3 adjoining the blacksmith shop, and installed in a new building planned and erected for the purpose, situated east of and partly adjoining the erecting shop, opposite machine shops Nos. 4 and 5. The new power building will be of irregular shape, one story in height, and will comprise engine and boiler rooms and a small room for the apparatus belonging to the heating system. The outside dimensions of the engine room will be 155 feet 9 inches by 59 feet 6 inches and the boiler room 103 feet by 74 feet. The west wall of the engine room only adjoins the erecting shop, while a space of sixteen feet will intervene between the boiler house and the erecting shop. The apparatus belonging to the heating system will be housed in a separate room eighteen feet by twenty-nine feet six inches, opening out from the boiler room on the south side.

The power plant will contain a model equipment for all power purposes. The engine room will contain an Allis-Chalmers, cross-compound air compressor, air cylinders eighteen inches by thirty inches, steam cylinders eighteen inches by thirty inches and forty-two-inch stroke; also an 800-kilowatt Allis-Chalmers cross-compound engine generator unit, a 1,500-kilowatt Allis-Chalmers steam turbine generator unit, and a 500-kilowatt steam turbine generator unit.

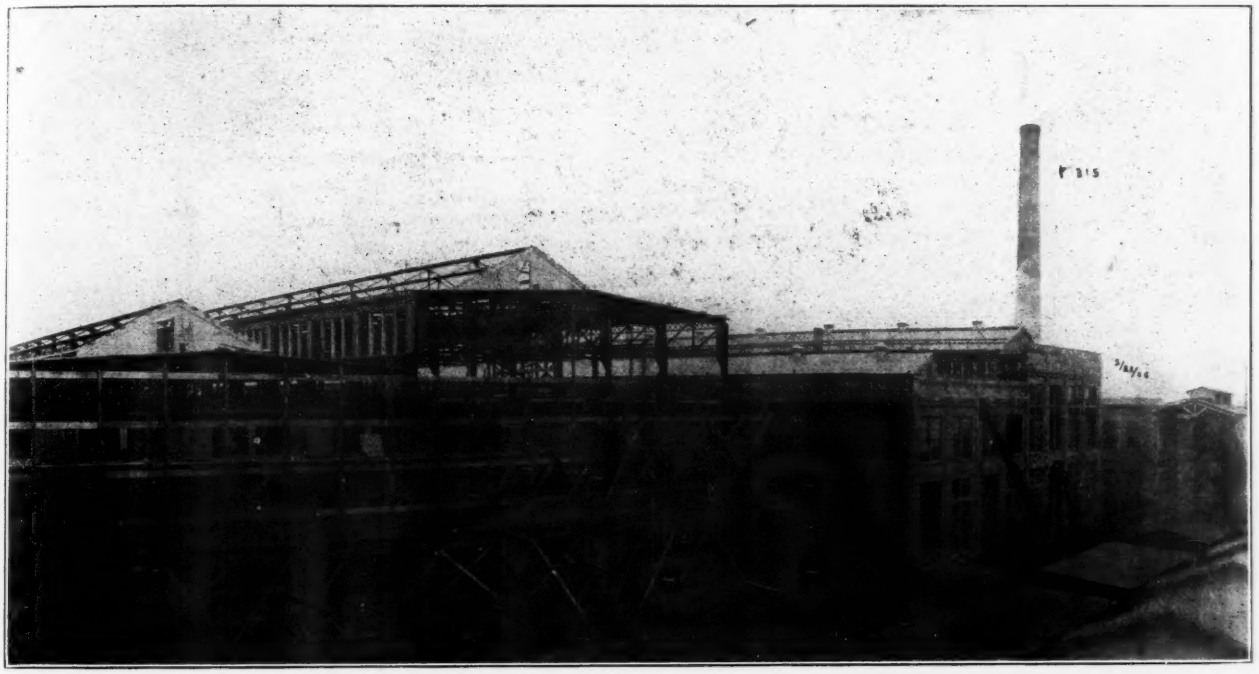
The boiler room will contain for the present, five 625 horse-power Edgemoore boilers, with two more boilers to be added later, a super-heater boiler, feed water heater, etc. The boilers will be equipped with underfed stokers, and an elaborate coal storage and handling system will be used.

The coal will be stored in overhead bins with a capacity of 700 tons or fifteen days' supply. Coal will be brought to the boiler room door in cars and conveyed to a breaker installed in the basement of the boiler room where the coal will be reduced to the proper screen. The coal is then conveyed to the overhead bins by the same elevator system which automatically conveys the ashes from the boilers and dumps them into cars outside, ready to be hauled away.

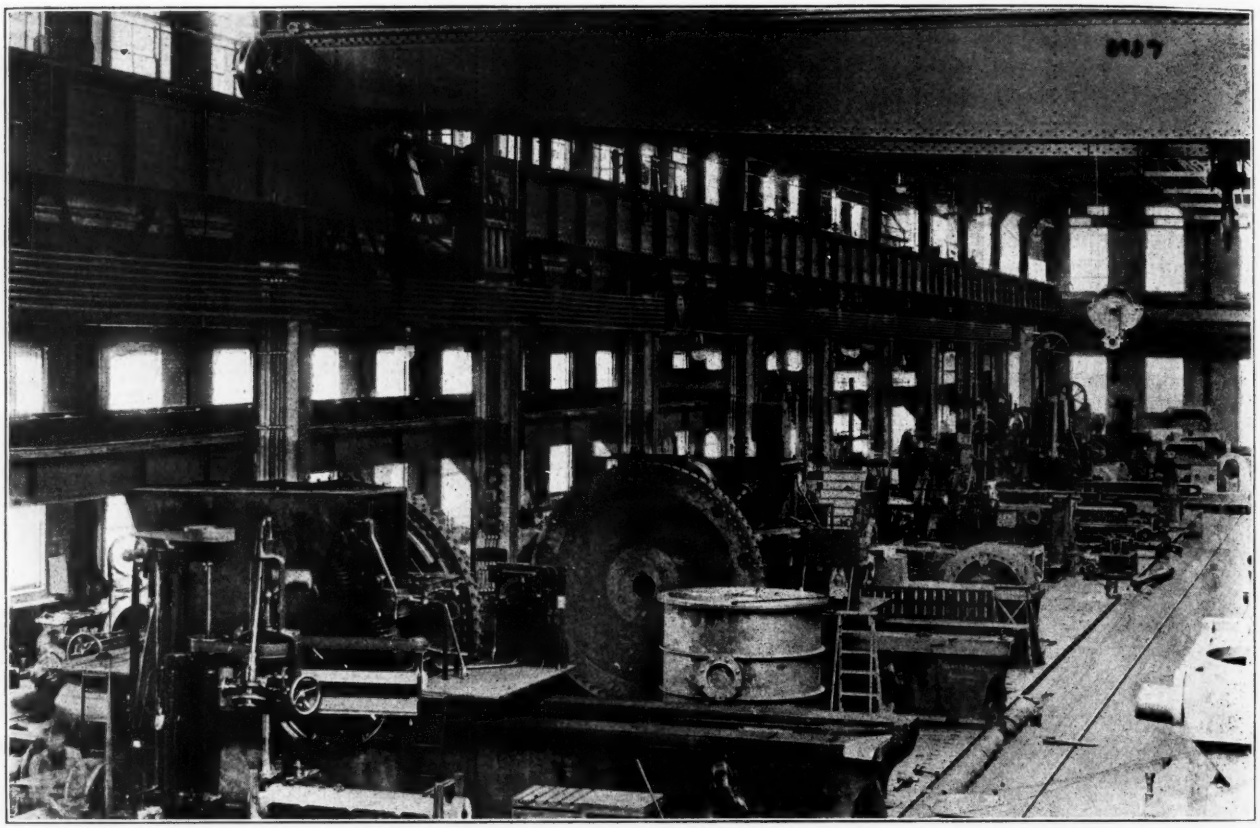
The boiler house will have a 100-foot self-sustaining steel stack for each battery of two boilers, or three stacks for the present. They will be eighty-four inches inside diameter.

Condensing water will be supplied for the use of the turbines from a reservoir 250 feet long by 200 feet wide and fourteen feet deep, which will be built of concrete material on low ground north of the erecting shop. This reservoir will have a capacity of five million gallons pumped from the present artesian wells, and will constitute one day's supply of condensing water for a 2,200-kilowatt plant. The tank is located on the low ground in order to place the foundation on hard clay with the minimum amount of filling. There will be a seven-foot lift on the pumps from the reservoir to the condensing apparatus.

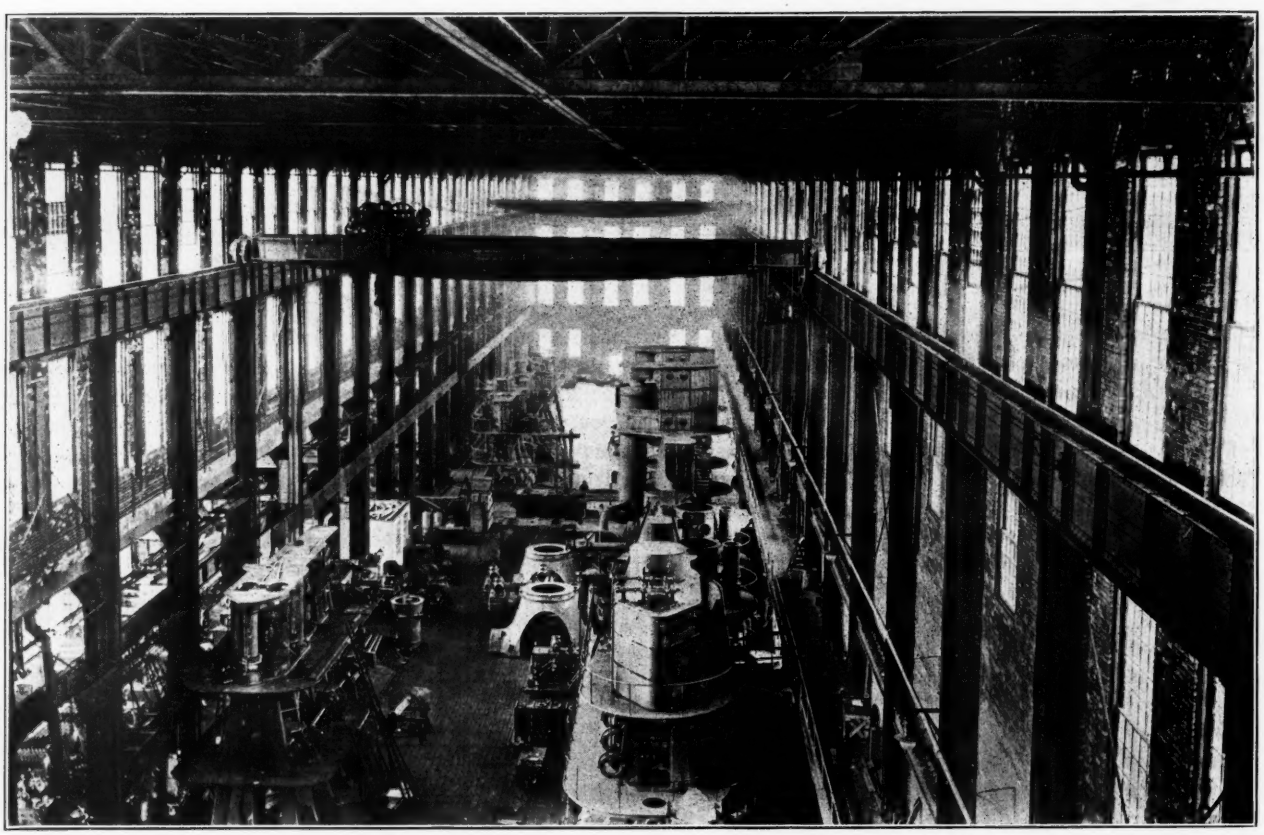
The heavy machine tools of various kinds installed in units Nos. 1, 2 and 3 will be duplicated for units 4, 5 and 6, supplemented by tools suitable for specific service, as for example the building of steam turbines and turbo-generators, gas engines, etc. One order recently placed covered forty-two machine tools of extra heavy pattern, involving a heavy expenditure. These tools were all designed especially for use with high speed steels and driven by Allis-Chalmers motors. The combined weight of these tools without the motors used for driving them aggregates 2,141 tons. Fourteen of the new machines are vertical boring and turning mills, from eight to sixteen feet, of extra heavy design. There are five standard shaft lathes and two crank shaft lathes with a swing of from sixty to 125 inches, and thirty feet between centres; eight planers of various sizes, all of which are the spiral geared type; a 260-ton armature press; also several drilling and boring machines, slotters, etc. Over 1,200 horse-power in Allis-Chalmers motors will be required to drive the new equipment described. In addition to the machine tools, thirty-four electric traveling cranes have been ordered for sizes and capacities ranging from two and one-half ton wall jib cranes to sixty-



EXTENSION, LOOKING EASTWARD, OPPOSITE MACHINE SHOP UNITS NO. 5 AND NO. 6.



VIEW IN MACHINE SHOP NO. 1, WEST ALLIS WORKS, ALLIS-CHALMERS COMPANY, MILWAUKEE, WIS.



A CORNER IN THE ERECTING SHOP OF THE WEST ALLIS WORKS OF THE ALLIS-CHALMERS COMPANY, MILWAUKEE, WIS.

ton seventy-eight feet span cranes with ten feet auxiliary hoist for the foundry extension.

The system used for storing patterns and which renders each readily available for use when required, is greatly simplified by the use of electric telphers running through the various sections and by push cars and elevators. The telphers are supported on overhead I beams and have a capacity of three tons each.

Direct current at 250 volts is distributed throughout the building for operation of motors used for machine tool drive. These motors are largely operated on the Bullock multiple voltage, five-wire system, making twenty-seven different speeds possible for each machine.

The heating system utilizes exhaust steam passed through a closed heater, corresponding to the primary heater in a condensing system. An auxiliary, live steam heater is provided to operate in connection with the exhaust steam heater for cold weather. The hot water thus obtained is circulated through the works by means of two centrifugal pumps electrically driven. The total space to be heated is 26,000,000 cubic feet traversed by 500,000 feet of one and one-half inch hot water pipes. Water for all purposes is obtained from four artesian wells located on the property, pumped automatically by motor driven, deep well pumps, through eight-inch pipes to four cisterns near the power-house. These cisterns are of concrete construction, each of 100,000 gallons' capacity with steel concrete roofs. A pressure of 100 pounds is kept on the mains at all times, which can be raised to 140 pounds.

VIEW IN FOUNDRY OF WEST ALLIS WORKS OF THE ALLIS-CHALMERS COMPANY, MILWAUKEE, WIS.

The yards between the various units are as completely equipped with cranes as the interior of the buildings, the storage space thus made available, proving very serviceable. Seven cranes are provided for use between the various machine shops and the foundry and pattern shop.

Electrical Power for the Textile Mills of India.

A problem of very serious import to the mills of India is now in process of development, says the *Indian Textile Journal*, Bombay. The efficiency of the mills is presently to receive an impulse far in excess of anything that could be obtained by working overtime, and this advantage is one that is not likely to be subject to fluctuations such as are common in the price of staple materials of manufacture. For many years these mills were run with English coal, then by slow degrees they learned to utilize the coal of Bengal, or Hyderabad, and now they are within measurable distance of water power as a prime mover, carried from the mountains to the factory in the form of electric current. As the capital outlay for any manufactory will, under the new conditions, be reduced to little more than the cost of the building, machines and minor shafting, a very great development of industrial ventures of many kinds is anticipated and a proportionate increase in the demand for machinery and metal work. The extension of the spinning and weaving industries will probably take place outside of the island of Bombay, drawn thither by cheaper land and cheaper labor. Any reduction in the cost of manufacture of cotton goods in Bombay represents increased powers of competition with English mills; the extent to which this competition may be carried, will depend on the powers of organization of the Bombay mill-owner, but it will be safe at least to say that the textile machine maker may look forward to a considerable increase of business with India.

Calcutta, although less favorably placed than Bombay with regard to water power, has the Bengal coal mines sufficiently near to suggest a power scheme in which the coal will be burnt at or near the pit's mouth, to drive the steam turbines of a large power station, whose energy will be transmitted in the form of electric current to the manufactories of the capital. This scheme is already under consideration, and as it only follows the example of other projects already at work, there can be little doubt of its ultimate realization. The use of a Bengal coal field as a central power station will doubtless suggest similar developments in other coal regions of India—a matter which will be of interest to the makers of steam and other prime movers, which depend on the combustion of coal fuel or oil. In a very few years many of these projects will be in course of development, and will create a new and very great demand for workmen accustomed to deal with machinery and mechanical processes. So much of the cost of repair and upkeep depends on the quality of the men in charge of machinery, that already the prospective demand for skilled artificers should have full consideration in the course of instruction given in primary schools. Until quite recently, the influence of the teaching was to lead all the brightest boys into clerical employment. What is now wanted is a training, which will turn the minds of the children to handicraft. Short of this, the only alternative will be to import skilled labor from other countries, just as capital has had to be imported from abroad to develop many of India's most important industries. This would be nothing less than a calamity for India.

Colorado Electric Light, Power and Railway Association.

The next convention of the Colorado Electric Light, Power and Railway Association will be held in Denver, Col., September 18, 19 and 20. The programme for this meeting will be announced later.

ENGINEERING HONOR.[1]

BY SCHUYLER SKAATS WHEELER.

While I have prepared in writing something of an annual address, as required by the constitution, I shall try to express the substance of my theme to you directly, because I attach some importance to the emphasis that can be given only in this way. All that I would say has been summarized by Francis Bacon in the preface to his "Maxims of the Law," where he says:

"I hold every man a debtor to his profession; from the which as men of course do seek to receive contenance and profit, so ought they of duty to endeavor themselves by way of amends to be a help and ornament thereunto."

I feel that I can not make a better use of the opportunity afforded me by this occasion to reach electrical engineers and the engineering profession, nor can I do our profession a greater service, than by raising my small voice in support of the principle so admirably stated by Lord Bacon. I will use my opportunity to urge that engineers interest themselves in improving the moral standard or the ethics of the profession and in strengthening their sense of the obligation that binds all engineers to a course that is particularly honorable.

We, as engineers, are accustomed to hearing ourselves referred to as professional men. The habit of calling us professional, though not strictly accurate, does no harm, and by encouraging us to greater care and conscientiousness ought to benefit. The relations between the clergyman, physician, or lawyer and his parishioner or client are regarded by law and usage as especially sacred and inviolable, and the obligation imposed upon the professional man to be faithful to the interests of the client or protégé is equally strong. It is not in my mind to dwell upon these relations or even to attempt to describe them, because they are well known and established and the subject has been treated by many great authorities.

My wish is to draw the attention of engineers and others who are engaged for the people in handling the forces of nature and in interpreting its laws, to the propriety and necessity of regarding themselves as in the same category with the strictly professional man. The attitude of the public contributes to this obligation. The public considers (much more than there is reason for) that the several branches of engineering are special subjects and not easily within the comprehension of the layman, and therefore it places itself in the hands of the engineer. He is thus put under the utmost moral and professional obligation. The duty is as great as that of the physician to his patient, although engineers as yet do not generally recognize such responsibility.

On the other hand, the public finds no such declaration of high standards in the engineering profession as in the older professions. It is therefore inclined to treat the engineer lightly in ethics, and to withhold from him that deference which, if rendered, would in itself encourage a higher professional standard.

That much thought has already been given to the subject by engineers, architects, etc., is shown by the numerous discussions which have taken place in many of the societies. The conclusions reached by many of them, as expressed in the several codes of ethics formally adopted for the guidance of members, are very interesting and helpful. I ask "leave to print," at the close of these remarks, reference to these discussions and codes, with acknowledgment for the valuable assistance of my friend, Mr. Edwin Burt Douglas.

In a few cases, however, being prepared principally with a view to the relations of the members of the profession to each other, these codes are rather narrow and in the style of labor union rules. This suggests that greater weight be given in them to the interests of the client and the interests of the public.

The electrical branch of engineering, being the youngest, has not yet formally taken up the question of ethics, but should do so and will have the aid of the experience of all other branches of the profession.

The moral duties of the engineer may be summarized as follows:

First, the duty to the client. To see that his interests are protected, that he is wisely educated or advised as to what he ought to have. That he gets it. That information pertaining to him does not reach others.

Second, the duty to the public. To see that the public is not imposed upon by misinformation. The newspapers are full of descriptions of schemes which mislead the public and of wildcat stories that are a reflection on the engineering profession. Engineers are frequently called upon to discuss such schemes and to point out their absurdity; and are frequently unable to convince the layman that they are without merit, because the public mind is not sufficiently educated in engineering matters and because the professional standing of engineers in the community is not high enough.

Third, the duty to the engineering societies, which involves contributing to their welfare, both in time for administration and the preparation of technical contributions and discussions, and in money. There are three reasons for this obligation: first, the society represents the art or craft by which the engineer supports himself. Surely he owes it some debt; second, it is to his advantage that the branch to which he belongs should attain a position of strength and recognition, and that it should command respect for its opinions and endorsements; third, he should so conduct himself as to stand well in his society, whose members are his peers, and are therefore the men whose commendation the world will accept.

THE ENGINEER'S DUTY TO HIS CLIENT.

This is, of course, the most important obligation to be considered, and the one to which all others must give way if there is any conflict. This is the direction in which improvement in the attainment of loftier ideals, which may be expected from natural evolution as time goes on, will be most appreciated by the public, since in this direction the public is most affected. It is hardly necessary to say that the client is entitled to the very best there is in the engineer in thought and in service or execution, and I mention it only to make the statement complete. In drawing a comparison between our profession and the older or recognized ones with a view to selecting the lines along which we should try to guide our evolution and improve our standards—while I believe that the essential principles involved are the same, and that we should set our aim at as high and even a higher standard—there are some considerations which must not be neglected and which necessarily call for the employment of slightly different means in attaining the same end.

Many supposedly independent consulting engineers have affiliations with engineering or manufacturing concerns interested in the introduction and use of a particular apparatus. The engineer usually recommends the same apparatus, and its manufacturer recommends the engineer to clients. It is often held that the best engineers are subject to such affiliations, because the best are sought after and the absence of such affiliation is an indication of lack of capacity. This is not completely true, and there are many good men doing

[1] Presidential address delivered at the annual convention of the American Institute of Electrical Engineers, Milwaukee, May 28.

general work, though not nearly so large a proportion as of general practitioners in law or in medicine. The circumstance, however, imposes upon those who are subject to such relations the obligation to be especially careful when advising clients to acquaint the client fully with the fact of such relation and to divest themselves at the moment of any influence which might bias their judgment. Their advice will then have the increased value due to their special knowledge and experience.

Another fact which differentiates engineering from other classes of professional work is that study and work for a client takes the shape of drawings and data, which are usually regarded as the property of the engineer and not of the client. Such records are often voluminous, and are an exact statement of the affairs of the client as far as they go. Obviously, the custody of such matter involves important points in the relation of the engineer and the client, and if misused the consequences to the client may be serious. Even when an engineer is on the simple basis of an employé, it is sometimes suggested that sketches and data, such as may be contained in note-books, are his personal property. In this connection, the fact that nearly the entire work of the engineer is reduced to and is represented by drawings and figures as stated, gives the subject great importance. Perhaps here is the greatest difference between the engineering and the other professions. There is no parallel in the so-called learned professions, and the client or patient, almost without exception, employs aid simply for experience and advice, and at no time does occasion arise for the reduction to a minute record of the preliminary or final results. In this respect moral responsibility devolves upon the engineer in greater degree than upon others. The point may well be illustrated in a more ordinary connection by considering the possibility of a manufacturer, founder or artisan furnishing to strangers articles made from designs, drawings or patterns, the property of others which happen to be in his possession.

Professional relationship between the engineer and client in respect to its confidential nature and its inviolability is not thought to be like that of the physician or lawyer to client or patient, and is not so recognized by law. I believe the courts should so recognize it, and in any event the engineer should so regard it as applying to himself, and if anything should be even more scrupulous than the physician or lawyer. In these days most engineering is done for corporations, but while corporations are "artificial" persons, they are nevertheless created by the state, and therefore the state has the right to dissolve them, to examine their books, to ask questions, etc.—rights which the state does not possess in the case of individuals. While this difference between the legal rights of corporations (which form the bulk of the clients of engineers) and the legal rights of individuals (who form all of the patients of doctors, all of the charges of clergymen and many of the clients of lawyers), is not the cause of the difference in the legal status of the engineer's confidential advice compared with the advice of the physician or lawyer, it is yet suggestive of it and throws light upon it. Therefore, engineers should be the more careful in regard to matters of confidence.

To the engineer whose work is educational, and whose clients are therefore his students, is given the opportunity to exercise at once the most direct influence for engineering honor, by his teaching. We may, therefore, expect that the profession will receive its greatest help from him.

THE ENGINEER'S DUTY TO THE PUBLIC

Is largely educational or instructive. If the public believes that engineering is a subject it is not fitted by talent or training to deal with, whether it is justified or not in this belief, is not the engineer under the strongest obligation to guide it aright? When a man trusts you, you are bound to respect the trust, or you will lose your standing. We all know that a mass of misleading, foolish and sometimes deliberately deceptive information on engineering or scientific subjects is given out, circulated and published. All of this by its ultimate failure brings our occupation into disrepute. Many engineers, when asked, reply correctly, pointing out the misstatements and errors; but how many of us try to be good teachers? How many of us take care to see that the real facts, the real situation, the real need or the real possibilities are made plain to the layman? Take an ordinary case, such as the almost daily statement that some one has invented a new motor (not necessarily electric), so powerful that trains can be run a hundred or two hundred miles an hour by it. Assume that there are ten thousand engineers in the United States, I suppose that one thousand of these say each time the subject is brought to their attention that it is absurd, that they don't believe it, that it has been tried two or three times but never successfully, etc. How many of even the thousand do you suppose take enough interest in setting the public right, to spend enough time to say that travel at any such speed is entirely a question of roadbed and right-of-way, that it is easy enough to make motors of almost any kind having power enough to pull a car or train at these speeds, but that practical roadbed conditions prohibit it, and that the most perfect track ever built is so irregular that the train would be liable to jump the track at such a speed. Those who give true educational explanations in form digestible by the laymen, do their duty to the public, and do it and their profession a service. It ought to be clear to every engineer, and it probably is, that the more the public is enabled to understand the real facts, the more discriminating an audience it will become for the appreciation of really meritorious feats of engineering. At present I fear that in the public estimation, telegraphing to Mars is far ahead of getting the dry dock "Dewey" to Manila. When a man who is in a position to know, either as a result of training and education, or of Heaven-sent talents, is asked, by one who does not know, any question about engineering, physics or the laws of nature, and he does not set that man right to the best of his ability, he is shirking his duty. Possibly he is assuming that he has a patent on some of the laws of nature, or a part interest. This view would not raise him in any one's estimation.

Another example occurs to me. I have seen a man as a witness in court after qualifying as a patent expert, which means that he is officially clothed with authority as an engineer, and that he is there for the information of the court, spend hours and even days framing numerous answers to a single question, his sole object being to avoid, if possible, making a simple statement of the truth. The mistake, of course, is that the man confuses his duties and acts as an advocate, while the public understands that he is there as an engineer to make clear the facts. The result is well known and gives rise to the saying, "Liars,—liars and patent experts."

The example serves my purpose well in illustrating by extremes what I mean when I say that it is the duty of an engineer to give the public the truest and simplest explanation of each engineering question when it comes up in his community, taking care to put it in such form as will be understood.

THE ENGINEER'S DUTY TO HIS PROFESSIONAL SOCIETY.

The other duties of the engineer I have placed before his duty to his professional society, because this latter relates to his solicitude for himself and his fellow engineers as distinguished from his solici-

tude for his client and for the public. The principle of doing something, however, for "your crowd" is so well established and recognized that it does not need full discussion here. I think even some animals act upon this principle. The institution of crafts, societies, fraternities, guilds, and the like, is very old, and the reasons for them are sound and well known. Yet there are those who pay no attention to the official society representing the profession to which they belong. Rare and peculiar birds!

Unfortunately, some societies are at times not well run. The meetings are sometimes monotonous; owing to the presentation of matter which does not happen to relate particularly to or interest the members then present. The groups of men are not well balanced, some being older men with wide experience, while others are the beginners, and sometimes the meeting quarters are not comfortable. None of these things is an excuse. If the profession is young and poor, so are you. If you have prospered, you are a member of an important and successful profession, and then if the quarters are poor and the society not strong, it is your fault, because you have not contributed enough to make a society important in proportion to the position you have attained by work in the sphere of activitv which it represents. There are many ways in which you can support, encourage, and contribute to the dignity of your professional society, and you can select those means which are most agreeable to your own methods. Even the mere attitude of approval of the society is of great value. It is well to give your profession and the public to understand that you believe in your society and follow its recommendations and standards.

A more commonplace but none the less positive reason for your obligation to contribute to the support of your society, is that you are earning your living out of the art which it represents and which it is trying to dignify. Your obligation is therefore definite. It is also greatly to your interest that your profession be made as important and its position before the world as commanding as possible; and it would not be right were you to allow other professionals to bring about this result without your aid and then for you to reap any benefit from it.

In conclusion, I will mention what I believe to be the broadest and most important function of professional relations, —an engineer's standing or the way in which he is regarded by his contemporaries. All the world recognizes that the best judgment of a workman is by other workmen, of a woman by other women, of a lawyer by other lawyers; likewise the best estimate of an engineer as a man and engineer is by the members of his own profession.

The Faraday Society.

The twentieth ordinary meeting of the Faraday Society was held on Tuesday, May 15, 1906, at the Institution of Electrical Engineers, 92 Victoria street, London, S.W. Dr. F. Mollwo Perkin, treasurer, was in the chair.

Mr. H. D. Law, B.Sc., read a paper entitled, "Behavior of Platinized Electrodes."

The author desired to find an electrode on which the reduction of the aromatic-aldehydes and similar easily reducible compounds could not be effected. Platinized platinum, as being the metal from which hydrogen is liberated at the lowest potential, was tried as the cathode in an acidified alcoholic solution of benzaldehyde. At first, energetic reduction took place; the activity of this, however, diminished in successive experiments, and was extremely small after twelve hours' polarization. The cause of the reaction is obscure; it is probably catalytic in its origin.

Dr. N. T. M. Wilsmore drew attention to Tafel's work, which the author's results appeared to contradict.

Dr. F. Mollwo Perkin remarked on the differences between lead and platinum electrodes, and discussed the general bearing of the author's experiments.

Mr. Julius L. F. Vogel, M.I.E.E., M.I. M.M., read a paper on "The Electrolysis of Fused Zinc Chloride in Cells Heated Externally."

The author begins by explaining that the work which formed the subject of the paper was carried out for the most part between 1898 and 1901, and could be conveniently divided into three periods. He then explains how the investigation came to be undertaken; the original inception of the process was due to the late F. Maxwell Lyte, who took out patents for a complex ore process, involving the electrolysis of fused zinc chloride and for the dehydration of zinc chloride. The process as such was never investigated practically. The second period deals with the investigation of the dehydration of zinc chloride by evaporating under reduced pressure, and the electrolysis of the salt in a fused state in externally heated cells by Dr. O. J. Steinhart and the author jointly on behalf of the Smelting Corporation, Limited. The various experiments and the apparatus employed for these experiments are described. The third period deals with the further investigations made after the United Alkali Company had joined the Smelting Corporation in testing the process, and details are given of the work as carried out under the joint supervision of the author's firm and the chemical staff of the United Alkali Company. The author describes how the process was carried successfully to a stage when continuous electrolysis was carried on for eleven days and nights, and three cwt. of pure zinc was produced.

The author finally reviews the work done in cells heated externally, and expresses his opinion that the process was "non-proven," and it offers possibilities of being carried to economical success.

The paper is illustrated with sectional drawings of apparatus, and lantern slides, prepared from photographs of the actual plant, were exhibited.

Dr. O. J. Steinhart referred to the production of zinc from zinc oxide by feeding the latter into a molten bath of chloride, after the fashion of aluminum electrolysis.

Mr. W. Murray Morrison mentioned some of the advantages of internal heating with regard to local inequalities of temperature.

Dr. H. Borns referred to the formation of zinc clouds diffused in the electrolyte under certain conditions, and consequent reduction of efficiency, observed by Lorenz. He asked whether the addition of impurities, such as ammonium chloride, had been tried. Evaporating with HCl was a method of dehydrating chloride.

Mr. L. Gaster asked for information regarding comparative energy losses in externally and internally heated cells, and also regarding the consumption of carbon.

Dr. G. Rudorf (communicated) after reviewing the various methods proposed for dehydrating the chloride, affirmed that the author's was the only practicable one. He asked for information regarding the effect on the enamel of continuous heating with zinc chloride; his experience was that a perfect enamel was not obtainable.

Mr. J. L. F. Vogel, in reply, said that the use of a fused metallic cathode and proper temperature and other conditions prevented the formation of zinc cloud. Carbon losses depended greatly on the dehydration; they had not had opportunities of trying Acheson graphite. It was undesirable to add foreign substances as these would accumulate in time; it was likewise impracticable to dehydrate in the fashion referred to by Dr. Borns. The difficulty in electrolyzing a solution of ZnO in fused chloride was that the solubility was slight, and at the high-current densities demanded by practice not sufficient oxide would pass into solution.

SOME PHYSIOLOGICAL FACTORS IN ILLUMINATION AND PHOTOMETRY.[1]

BY LOUIS BELL.

The fundamental difficulty in the scientific study of illumination is that one has to define physical quantities in physiological terms. Illumination in all its phases deals with the sensation of sight, and between the one and the other there are no fixed relations, but only variable approximations. One can, therefore, rely only upon average conditions, restricted within somewhat narrow limits. The purpose of this paper is to point out some of the bearings of physiological optics upon practical illumination, its measurement and the limitations of its efficiency.

Save for the effects of accommodation and convenience in determining vision in three dimensions, we see things wholly by their differences in color and in luminosity. If two objects are of the same color and luminosity they cease to be separately distinguished, and as they approach this condition they become progressively more and more indistinct as individual forms. If the difference of luminosity is small the color difference must be increased to secure visibility, and *vice versa.* It is perfectly astonishing how objects of similar luminosity and quite different color or of similar color and quite different real luminosity can melt into the general landscape as soon as they are beyond the range of material help from binocular vision.

According to Fechner's law, the human eye can perceive a fixed fractional difference of illumination, irrespective, within wide limits, of its absolute amount. This fraction varies in general from about one per cent to about 0.55 per cent, assuming ordinary sources of illumination and normal eyes.

Now for the purposes of practical lighting, the illumination should be generally kept within the range for which Fechner's law holds good, and once well within that range of normal sensibility nothing is gained virtually by increasing the strength of the illumination, so far as difference of luminosity is concerned.

But this is not all, for visual acuity also enters the problem. By this one means the power of discriminating fine details, assuming strong contrast between them. This, although it depends primarily on the retinal structure, also varies considerably with the illumination, as every one knows. There is also a tolerably obvious but little understood relation between sensation and the area of the retinal image. The smaller the image, the brighter must it be to produce a distinct sensation. Thus, for example, small objects seem distinct enough at moderate distances and blend into the general landscape as their distances increase. In artificial illumination this phenomenon is seldom of importance. In order to see things with satisfactory distinctness the illumination must be sufficient to bring the eye to its normal acuity and to give to Fechner's fraction somewhere nearly its normal value.

Starting now from Fechner's fraction and from the facts of visual acuity let us see whether a logical basis for illumination can be devised which shall thus rest not upon purely empirical observations of good and bad lighting, but upon the general data of physical and physiological optics. Thanks to the work of König and Brodhun, and of Uhthoff, one can get a clear idea of the variation of Fechner's fraction and of visual acuity with the strength of illumination. In Fig. 1 these relations are plotted with the illuminations in foot-candles, as abscissæ. Curves *a* and *b* relate to Fechner's fraction with $\frac{d\,I}{I}$ as ordinates.

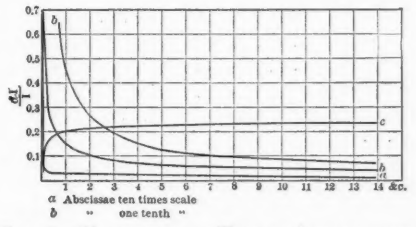


FIG. 1.—VARIATION OF VISUAL ACUITY WITH STRENGTH OF ILLUMINATION.

Curve *a* shows the variations found up to 140 foot-candles, while curve *b* is on 100 times the scale as regards abscissæ, running therefore to 1.40 foot-candles. I use the foot-candle as unit, not because I prefer it, but because the English standard candle is the only legal unit for practical use.

A glance at curve *a* shows at once that by the time the illumination has reached the neighborhood of one foot-candle the curve is turning clearly toward the horizontal and that beyond, say five foot-candles, the decrease in the sensibility is very slow indeed. Curve *b*, in fact, shows that the curve is rapidly getting asymptotic at even one foot-candle. These curves are for white light, and the question may naturally be asked as to whether they also hold for colored light. At low intensities they do not, the sensibility for red being considerably less, and for blue somewhat greater than is here shown. Curve *b'* shows the approximate values for deep crimson. Eyes differ considerably in absolute, and in color sensibility, but *b'* will give an approximate notion of the color effect at its worst. At high intensities, say about twenty-five foot-candles, the color curves run together.

Difference of visibility in colored objects, however, is only in small measure due to the facts here noted, being mainly chargeable to mere differences in reflecting power.

Curve *c*, Fig. 1, shows the variation of visual acuity up to fourteen foot-candles, the ordinates being purely empirical values. It at once appears that the increase in acuity is very slow above about one foot-candle, but goes on increasing slightly, like the shade perception, above all working values of the illumination. In extremely intense light, several thousand foot-candles, the sensibility decreases slowly, and probably also the acuity, but these upper limits are quite beyond the limits of ordinary illumination.

It therefore plainly appears that at one or two foot-candles the eye is working so near its normal sensibility that further increase in illumination is of relatively very small value.

The essential point in good seeing, however, is that the values here specified should be those affecting the eye and not merely those by which objects are illuminated.

Since objects are seen in virtue of differences of reflected light, the illumination which affects the eye is determined by the coefficients of diffuse reflection of the objects in the field of view.

The light reflected from any object is IK where I is the incident illumination, and for this to have the value required by the visual conditions just indicated, $I = \frac{a}{K}$ where *a* is the absolute factor just found. For example, taking $a = 1.5$ as a mean value, and the case of working upon white paper for which *k* is ordinarily 0.6 to 0.7, I, the incident illumination, should be two to 2.5 foot-candles, while with moderately dark colored papers having *k* equal to, say 0.3, the necessary illumination would rise to five foot-candles. With black goods for which *k* is only 0.01 or 0.02 one can hardly get enough light to bring acuity and sensibility to their full values. For ordinary purposes not requiring extreme acuity *a* may generally be taken as one, while in observing very fine details two or in very extreme cases three may be assumed. The surface observed acts as a secondary source of illumination, and for details small compared with the normal visual distance

[1] Abstract of a paper presented before the Illuminating Engineering Society, June 8.

the law of inverse squares holds, hence the tendency to get the eyes close to the work in insufficient illumination. In weak light, say 0.1 or 0.2 foot-candle, variations of shade are perceived only with difficulty and one finds himself like the patient who stumbled because obstacles not strongly contrasted were invisible to him. At 0.5 foot-candle conditions are very greatly improved and useful illumination begins and above one foot-candle they may be considered normal, unless close detail is concerned, in which case more light is of some assistance. But the controlling factor in practical illumination is *k*, which varies widely with the luminosity of the colors concerned, producing apparent color relations which entirely mask the real ones already described.

Given therefore the general kind of work which is to be done under artificial light and one can reckon from general physiological and physical data the approximate intensity of illumination required. The lowest permissible illumination is, of course, for coarse work on approximately white objects, the highest for close discrimination of detail and shading in dark objects.

For very weak and very bright illumination the effect of pupillary diameter must be taken into account. So far as objects in the visible field are concerned there is every reason for keeping the illumination received from them quite near to the critical amount *a*, and so long as this is done the pupillary diameter, so far as these objects are concerned, remains reasonably constant.

The iris diaphragm of the eye responds by reflex action to light and other stimuli, varying in diameter from hardly more than a point in very intense light to a width in complete darkness so great that the iris actually retreats under the margin of the cornea. Ordinarily the aperture is such that the eye is working at f.5 to f.6. In strong light the aperture may fall to f.20 or beyond, and in very dark light it may rise to f.3 or thereabouts. Obviously the intensity of the image varies accordingly. If a bright light causes the pupil to contract abnormally the illumination available from objects in the field of vision is cut down and the normal sensibility of the eye may be greatly reduced.

Suppose for instance an eye receiving one foot-candle at its normal pupillary diameter, in such case not far from four $\mu\mu$. Let now a light enter the field of vision bright enough to contract the pupil to two $\mu\mu$ and the effect is the same so far as the general field is concerned, as if the available illumination were cut down to 0.25 foot-candle, which a glance at Fig. 1 shows to be too low for decent seeing. Hence, the importance of keeping bright radiants out of the field of vision.

The actual relation between pupillary aperture and intensity of illumination has been investigated with somewhat various results, much depending on the state of adaptation of the eye. In examining the classical experiments of Lambert on this subject a simple approximate relation appeared between the area of the pupil and the illumination, to wit, that the former varied with the reciprocal of the square root of the latter. Hence, if we take a

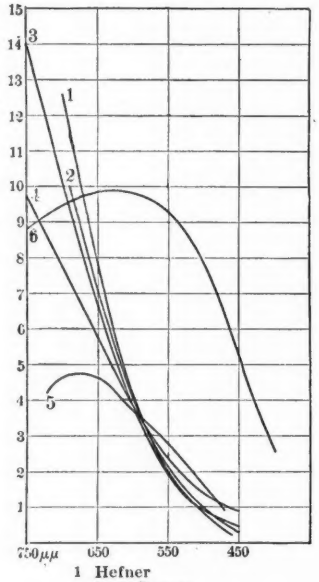


FIG. 2.—DISTRIBUTION OF ENERGY IN THE VISIBLE PART OF THE SPECTRUM FOR VARIOUS SOURCES OF LIGHT.

quantity U proportional to the illumination which reaches the retina, as the criterion of visual usefulness, then, again approximately $U = K\sqrt{I}$, which furnishes another cogent argument against trying to force the illumination too high. It is probable that the pupillary aperture is affected by the intrinsic brilliancy of the source as well as the illumination from it, but the exact relation remains undefined. This much is certain, that a light of too high intensity or intrinsic brilliancy within the field of vision tends to defeat its own purpose by automatically stopping down the iris. This is quite apart from the well-known and serious effect of such lights in causing retinal irritation, to which the loss of many an eye may be attributed.

Any violent contrast in the field of vision is objectionable for the same reason, in less degree, so that if conditions are such as to require powerful illumination in a part of the field a very bright background in the rest of the field should be avoided, it being preferable to have there merely enough light to avoid excessive contrasts.

As most objects are colored the relative luminosities of various colors are important considerations in illumination. That the eye is affected by various colors in very different degrees is well known, and the fact is responsible not only for great difficulties in photometry, but also for serious limitations on the possible efficiency of illuminants. While the luminous part of the spectrum lies mainly between wave-lengths 700 $\mu\mu$ and 400 $\mu\mu$ the effective part of it lies between wavelengths 630 and 530. Energy outside these limits is for the most part wasted so far as vision is concerned.

At first sight, therefore, the eye would seem to be very inefficiently organized. Such, however, is not the case, for the eye has been evolved not for artificial light, but to meet the exigencies of natural light, and its point of maximum luminosity falls very near to the point of maximum energy of the solar light, in fact, between that and the maximum energy point for skylight, so that the adjustment of the sensibility for natural conditions is excellent.

Moreover, were it not for the adjustment of the eye for a sharp maximum of sensibility, we should be totally unable to see clearly on account of the effect of chromatic aberration. When the eye is accommodated for yellow light, images due to deep red and deep blue light are badly out of focus, and were they comparable in brightness to the yellow image, near vision would be very indistinct, and aside from this we should lose much of the contrast which helps to render objects visible.

As was long ago noted by Purkinje and Dove, the relative luminosity of different colors is greatly affected by the absolute intensity of the illumination, a fact at once curious in itself and in photometry very troublesome. The comparison of colored lights involves this phenomenon to a very serious extent, and in particular all extinction methods are vitiated by it save when used merely for the comparison of lights of similar color or for the actual measurement of very low intensities. In fact, any photometric device which can be used on colored lights with coherent results

by both the normal and the color-blind, owes its apparent efficacy to disregard of part of the spectrum generally useful.

Now in using artificial illuminants, the real usefulness of the light evidently depends upon the amount of energy which falls within that part of the visible spectrum to which the eye is reasonably sensitive. In fact, the photometric principle laid down by Crova, of comparing lights by their respective components in the neighborhood of 590 $\mu\mu$ wave-length, had much to recommend it in dealing with sources which give a continuous spectrum.

The position of the energy maximum in the spectrum of an incandescent body is a function of the temperature, and unfortunately the temperatures available in flames, incandescent lamps and so forth are too low, say 1,800 degrees to 2,200 degrees absolute, to place this maximum where it will do the most good. In fact, to put the maximum where it ought to be requires the solar temperature itself.

Fig. 2, from the researches of Nichols, gives with arbitrary ordinates the distribution of energy in the visible part of the spectrum for various familiar sources of light. The first three curves are for ordinary incandescent solids and bear a striking resemblance to each other. Curve 4, from the electric arc, shows relatively more blue and less red than the others, thus corresponding to its higher temperature. Curve 5, from a Welsbach mantle, shows a considerable departure from the distribution of the normal incandescent body, due not to enhanced temperature, but to powerfully selective radiation. It indicates a very high luminous efficiency, since the maximum lies within the visible spectrum. Curve 6 is the solar radiation, which is from a temperature so enormous that the maximum is pushed up into the orange. Were one sure that the radiation is quite non-selective a pretty close value for the solar temperature could be obtained. As it is, it is only safe to say that the temperature is probably between 5,000 degrees and 6,000 degrees. These curves are, so to speak, the mere fag-ends of the total energy curves.

The efficiency of an illuminant in the sense in which the expression is ordinarily used is the ratio between the luminous energy and the total energy. In this estimate the luminous spectrum is commonly taken as beginning at wave-length 760 $\mu\mu$. Angström has found for the particular energy curve of the Hefner lamp that one square centimetre of surface one millimetre from the flame receives 8.3 ergs per second of luminous energy, which gives for this particular source a luminous efficiency of 0.9 per cent. Other things being equal, if all the energy were converted into light on the basis of this mechanical equivalent of light, we should have a possible duty for a radiation wholly within the visible spectrum of 0.115 watt per candle. But the visible light is really the summation within the visible spectrum of each element of energy multiplied by its corresponding coefficient of luminosity, and this summation is very different for different energy distributors. Nichols, from the application of Crova's criterion that lights of equal intensity at wave-length 590 $\mu\mu$ are equal, has made some most interesting approximations to the mechanical equivalents as derived from other illuminants reaching for sunlight 4.85 ergs per second and for the Welsbach on account of its selective radiation, as low as 4.39 ergs per second. A rigorous summation made as above would change these quantities somewhat, but the main point of the matter is that if one could confine radiation to the visible spectrum with as good a distribution as is given by the Welsbach or by sunlight one could secure artificial light on a duty of about 0.06 watt per candle. This, however, is not the limit, for if, in addition, one could crowd all the radiation into the neighborhood of wave-length 590 so as to keep σ near its maximum, one could get light at a duty of approximately 0.01 to 0.02 watt per candle, which is about the theoretical minimum. This would, however, be practically monochromatic light by which color vision would be impossible.

The flaming arc is the most efficient illuminant yet found, and M. Blondel has been able to obtain from it a duty in the vicinity of 0.1 watt per mean spherical candle, due to the very high luminosity of the two calcium fluoride bands near to wave-length 600 $\mu\mu$. But the light has a large color error which can be corrected only by a considerable sacrifice of efficiency. Undoubtedly, a discontinuous spectrum gives the best chance for high efficiency, but only at the cost of serious color errors. Even if one could obtain a discontinuous spectrum of the three primary rays only, it would be at a sacrifice, and there would be some doubt of its value as an illuminant on account of chromatic aberration in the eye.

Could one steal the firefly's secret, the result would be, if Langley's experiments correctly represent it, a light of high efficiency, it is true, but of about the color of a superannuated Welsbach. From all appearances, it will be extremely difficult to do much better than a duty of 0.5 watt per candle with an illuminant of reasonably good color quality.

The Ever-Present Telephone.

The completion of the occupancy of territory and the efficiency of telephone service in distributing information was recently illustrated in Massachusetts on the occasion of the promulgation of the appeal of Governor Curtis Guild for contributions to the sufferers by the earthquake in California.

This letter of the governor was read at a meeting of the relief committee, and given to the New England Telephone and Telegraph Company at five o'clock in the afternoon, and by eleven o'clock in the evening it had been dictated over the telephone and copied by the mayor, chairman of the board of selectmen, or their representatives, in every one of the 356 cities, towns, villages and hamlets in Massachusetts except two, one being a mountain village in the Berkshires and the other a fishing hamlet on the island of Martha's Vineyard.

The letter was also given to the editorial office of every newspaper in Massachusetts during the same time.

This information reached the cities and larger towns in time to provide for calling special meetings of citizens, and to be read before audiences already gathered together at theatres, concerts and other entertainments, enabling thousands to give twice by giving quickly.

This information by means of the telephone was promulgated to about three million people in about the same time that Paul Revere required in his midnight ride to warn the farmers along the turnpike of the foray of the British troops from Boston to Lexington.

Compare this with the weeks and even months required to disseminate information of declarations of wars and consummations of peace. The battle of New Orleans was fought six weeks after the treaty of peace was signed, and now information throughout the civilized world is a matter of simultaneous record.

It can be put down as a fact that no central-station manager who has failed to put into effect some plan to eliminate the first cost of the sign to the consumer has begun to encourage the sign business. An electric sign owned and controlled by the merchant brings in approximately half as much income as a sign installed on any good "free" proposition, and yet requires the same central-station capacity.

Reviews of Current Engineering and Scientific Literature.

The Energy, Duration, Dying Out and Resistance of Oscillating Sparks.

The development of wireless telegraphy in the last few years has made the study of electrical discharges one of great importance, and information is needed respecting the properties of spark-gaps and their influence upon the current and voltage distribution of the circuits. Previous experiences made with high resistances in the circuit show that a first approximation of the energy of the sparks could be assumed to be proportional to the duration of the discharge when the resistance of the circuit is less than of the order of one megohm. Later tests made by Koch with resistances varying between 5,000 and 100,000 ohms confirm these results, and M. A. Heydweiller here discusses them. They have shown that the characteristic of the spark resembles that of the silent continuous discharge, and can be represented by the equation $v = a + \frac{b}{i}$, where v and i represent the difference of potential and the current, and a and b constants, varying with the length of the spark. Starting with this formula, an analytical investigation of the conditions is made, from which equations are deduced for the energy of the spark, the duration and the rate of dying away. To test these equations, values found from practice are applied, and the two constants, a and b, thus computed. These agree fairly well with the values found experimentally. The author therefore concludes that the similarity noticed by Koch between the characteristics of spark discharges and silent discharges is confirmed for explosive distances as great as six millimetres. It is therefore permissible to use the differential equations proposed by Kelvin and Kirchoff in order to predetermine effects. In some cases simplifications are possible, enabling these equations to be integrated. The results thus deduced are in good accord with experimental results. It is thus possible to determine the constants and the spark, which are linear functions of the explosive distance, and thus deduce other values of considerable interest.—*Translated and abstracted from L'Éclairage Électrique (Paris), May 26.*

On Directed Wireless Telegraphy.

In the ELECTRICAL REVIEW for September 16, 1905, a brief description was given of a system of directed wireless telegraphy invented by Dr. F. Braun. In this article Dr. Braun begins a thorough analytical exposition of his system. Hitherto it has not been found possible to produce interference of light waves emitted from two independent sources, because it is not possible to control the phase of the luminous point, much less the phases of the various points which constitute the source of light of appreciable dimensions; but it seems probable that this may be done with electrical oscillations emanating from different sources, because it appears possible to control the phase differences between electric waves. Assuming a solution to have been found for the problem, as the author believes, it is obviously possible, by adopting electric waves of different phase, in conjunction with differences in distance obtained by a geometrical disposition of the various sources of electrical energy, to create around the sending station electric fields having different intensities in different directions; hence it should be possible to produce a direction of maximum intensity. The following combination seems to promise good results: a number of vertical transmitting wires are arranged in a parabola, and electrical oscillations are set up in them, differing in phase by the amount of phase difference which would be caused were a wave sent to each of these wires from the focus of the parabola. If the parabola of wires be considered as a reflector, the electrical oscillation set up at the focus would be thrown out along the axis as a plane wave. Indeed, such a system might be used, were it not for the fact that the dimensions of the reflector would be impractically great on account of the long length of the electrical waves. A few wires could not be used for the reflector, because but a slight amount of energy would then be utilized. Assuming, however, as stated above, that the oscillations set up in these different wires have the proper phase relation, the same effect will result, and a plane wave will be sent out from the oscillating system. It is not necessary to adhere to the parabolic form, for any desirable geometrical form may be chosen, provided, of course, the proper phase relations obtain. An advantage of the system is that the energy of the wave is represented by the total radiation from the wires making up the system, and this can be large. The disadvantages are that energy will be radiated at the back and at the sides of this artificial mirror. Also, the geometrical distribution leads to certain inconveniences in practice and conduces to energy losses. The author then takes up the analytical discussion of the proposed system.—*Abstracted from the Electrician (London), May 25.*

The Future Electrical System of Paris.

Last year the authorities of Paris asked for proposals for a comprehensive electrical system for the city. A number of responses were received from as many electrical concerns, in which various plans were proposed. Certain of these plans contemplated the installation of an electrical system to provide for the needs of the entire city of Paris; others dealt with certain sections of the city only. Although these proposals were received last December, no definite action has yet been taken, but the authorities have again called for proposals, and this time received eleven. In this article M. D. Hospitalier describes briefly the various proposals, commenting upon them, and concludes that none of them is as advantageous to the city as the original proposal made by the Société d'Etudes pour l'Exploitation de l'Energie Électrique à Paris, which was made last year and which is still standing. Briefly, this plan contemplates a system which will serve the entire city. The concession is to last for thirty years, but, under certain conditions, may be terminated in twenty-three. At the end of the agreement, the equipment will become the property of the city. The system proposed is three-phase at 10,000 volts, fifty cycles, for the primary lines, and two secondary distributing systems, one a two-wire, 110-volt, direct-current system, and the other a three-phase, 110-volt, alternating-current system. During the time of the concession the company is to pay to the city eight per cent of the gross receipts and forty-five per cent of the profits. The author points out that this proposal is the most satisfactory, for it not only covers the entire city, but assures the city a satisfactory return for the concession. In two or three minor points changes are suggested. He then calls attention to the urgent need of taking action in this matter at once. Already six months have been lost, and from the present stand there

is no indication that the matter will go forward immediately. In the meantime, every month's delay involves a loss to the city and makes the adjustment with the companies at present operating there the more difficult.—*Translated and abstracted from L'Industrie Électrique (Paris), April 25.*

Economic Considerations in the Design and Construction of Steam Turbines.

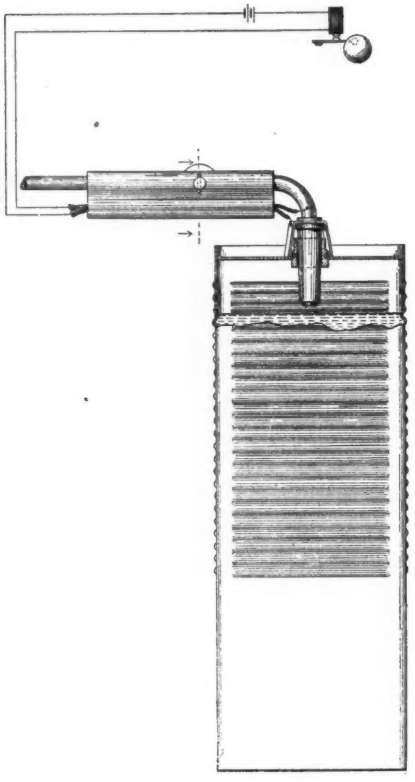
In concluding his long series of articles on the design and construction of steam turbines, Mr. Frank Foster deals briefly with certain economic considerations. Since the ultimate efficiency of the machine depends not only on its physical efficiency, but also upon such things as capital cost and maintenance, it is of the first importance that every effort consistent with sound engineering be made to produce a cheap machine. The best turbine is not, in general, the one in which economy of steam consumption has been the exclusive aim of the designer. The turbine which saves $500 a year in fuel, at the expense of $550 per year in increased fixed charges and maintenance, is not saving, but is losing. An example of the subordination of extreme steam economy to simplicity of construction is shown in certain types of design, where two or more sets of moving blades are included in each stage of the expansion. Such turbines are considered by the author to be less efficient thermodynamically; but the use of two or more sets of blades, mounted on one disc or wheel, considerably reduces the number of diaphragms and discs in the turbine, and thus tends toward a less costly machine. For running turbines only a few hours each day, and with cheap fuel, this mode of construction is undoubtedly justified. Whether it is justified where fuel is dear and the load-factor high is doubtful, and can only be determined after careful consideration. Another question affecting the efficiency is that of vacuum. Generally speaking, the vacuum obtained is only twenty-six or twenty-seven inches of mercury, yet certain firms work out their designs on the basis of a twenty-eight-inch vacuum. The question of the best peripheral speed is exceedingly important. Within limits, the higher the peripheral speed the more efficient the turbine. This question is important when determining the size of the blades. However, for a fixed speed of revolution it is not always true that the highest blade speed is the best. The cost of the turbines goes up rapidly with the diameter, nearly as the square. On the other hand, it decreases with the length, which decreases with an increase in diameter. The active portion of the turbine decreases very nearly inversely as the square of the diameter. For this reason there is some diameter giving a minimum cost of construction, yet this diameter may not be the best, as the factor of efficiency has been left out of account. Where a combination of reciprocating engines and turbines is adopted the load-factor on the turbines can easily be raised to thirty or forty per cent, in which case a very high vacuum, and probably high superheat, will be economical. As it is, forcing a turbine to work at high vacuum and with cheap fuel and a small load-factor is putting it under disadvantages, as compared with its rivals, with which it ought not to be saddled. Too often the ultimate commercial economy is made subsidiary to a good test result, while actually that turbine giving the smallest steam consumption is seldom the best.—*Abstracted from the Mechanical Engineer (London), May 26.*

Radioactivity and Volcanoes.

In spite of the popular opinion that a volcano is little more than a hole in the earth's crust, which acts as a safety valve to allow the escape of pent-up forces, it seems that, scientifically, these natural phenomena have never been satisfactorily explained. In this article Major C. E. Dutton, of the United States Navy, deals with the matter from a new point of view. Major Dutton has been a student of volcanoes for many years past, and, twenty years ago, advanced certain striking theories regarding them, although at that time there were not sufficient data obtainable to prove or disprove them. In the present article a number of facts are cited to show that the popular idea is not tenable. The first of these facts is the solidity of the earth. The second is the comparative smallness of the extravasated masses in any single volcano. To obtain an idea of this a segment of a section of the earth should be drawn, and on this should be laid out to scale a section of a volcano's reservoir of lava. From all obtainable records of volcanic eruption it has been found that the amount of lava thrown out is only, in the worst cases, two or three cubic miles. For the worst case on record it has been estimated that the discharge was six cubic miles of lava, but other authorities regard this as very excessive. These records show strikingly that the reservoir of lava is insignificantly small. Another fact as yet unexplained is the repetitive nature of volcanic eruptions. If these are due to a sudden breaking out of stored-up energy, why is relief not found in one violent eruption? But it is known that the eruptions take place again and again, thousands often occurring before the climax is reached and the decline of activity follows. Another fact, not proved, but supported by evidence, is that the seat of the reservoir is very shallow, and never more than three miles deep. This conclusion is reached from a study of the relative intensity of earthquakes caused by eruptions. These, as is well known, die out very rapidly, and hence can not be deep-seated. These facts seem to point to a gradual development of heat in the volcano, due to some cause. This heat gradually accumulates until a temperature is reached at which the steam always contained in lava lifts the mass of material above it, and an eruption takes place. It is not conceivable that these comparatively minute masses of molten material could have been in existence, embedded in the solid crust of the earth in a molten condition at a temperature of only 1,000 degrees or 1,200 degrees centigrade, ever since the earth has cooled down from a molten condition. If the reservoirs are presumed to be projecting arms of a central molten mass, that these small bodies would long ago have become solid, due to loss of heat, nor could the explanation be due to steam generated at great depths, since there the steam would not be able to lift the enormous weight of the material above it. The heat must therefore be generated in or surrounding the molten lava, and the author suggests that this heat is due to radioactive materials, probably radium. To support this belief, it has been proved that all soil contains radioactive matter, and from a few measurements a tentative figure has been reached which indicates that the heat developed by this radium is greater than that which can be radiated into space under normal conditions. It has also been shown that the waters from hot springs are strongly radioactive. The presence of a large amount of radioactive material at a volcanic reservoir would account for the facts mentioned above. Although radium has a relatively short life, its continued presence there can be explained by its formation from some parent material, such as uranium; in fact, it is believed now that the amount of radium contained in the earth has reached a stable point.—*Abstracted from the Popular Science Monthly (New York), June.*

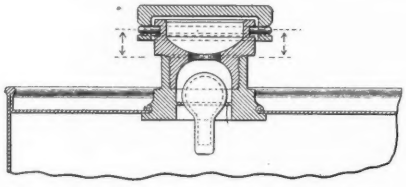
Electrical Patents.

Thomas A. Edison, of Llewellyn Park, New Jersey, has just secured additional patents on his storage batteries and the various methods and mechanisms associated therewith, and he has assigned the same to Edison Storage Battery Company, of West Orange, N. J. The number of his patent is 821,623, and it is dated May 29, 1906. One of these patents covers a simple and effective apparatus which has been designed for filling



Storage Battery Filling Apparatus.

the cans or receptacles of his improved storage batteries, the idea being to provide means for giving an indication when the proper level of the solution has been reached. It will be seen, however, that the apparatus can obviously be employed for introducing solutions into batteries of other types, whether secondary or primary, as well as for the filling of other receptacles—such as tanks, boilers, stills, etc.—with more or less conducting solutions. The objects are to provide a simple, compact and efficient apparatus for the purpose, arranged to give a positive notification when the solution or other liquid reaches the proper level and of such character as not to be likely to get out of order. To this end, the invention consists of an electrode depending within the receptacle and arranged in a suitable circuit adapted to be closed through the solution or other liquid when the latter makes contact with said electrode, thereby energizing a controlling magnet arranged to perform any desired notification, such as the ringing of a bell, the dropping of a shutter or the operation of a valve, rheostat, switch, or other device. Preferably the electrode in question surrounds or is formed by the filling tube. Another relates to an improved gas separator for storage batteries of the type employing the method described and claimed in his patent of the United States granted July 5, 1904 (No. 764,183). Heretofore use has been made of a perforated diaphragm or gauze in the top of the separator casing, through which the gases pass in a diffused and attenuated condition in order to prevent the possibility of an explosion within the can or receptacle. It has been found that dust and dirt are likely to enter the can through



Gas Separator for Storage Batteries.

this perforated diaphragm, thereby tending to clog the valve seat and contaminate the solution to injuriously affect the operation. The object of the invention is to provide a construction wherein dust and dirt will be excluded from the receptacle and at the same time the operation of the separating valve will be augmented. To this end, the invention consists of providing the separator casing with a cover or auxiliary valve which is normally closed to prevent the admission of any dust or dirt, but which will open by the accumulation of pressure beneath it to provide for the escape of the gases into the atmosphere. The number of this patent is 821,624, and it is dated May 29, 1906. In certain of his applications for letters patent Edison describes improvements in storage battery electrodes wherein the active mass, such as nickel hydroxid, is admixed with insoluble metallic scales or films for the purpose of insuring contact between the active particles themselves and between the active particles and the enclosing pockets or other metallic supports. These metallic scales or films are formed, preferably, of cobalt-nickel alloy, since by using this material the characteristically good contact obtained with cobalt is secured, while the presence of the nickel prevents the cobalt from suffering more than a mere surface oxidation. The present invention relates to an improved process by which metallic scales or films can be obtained at low cost, either of cobalt or of nickel, or of a cobalt-nickel alloy. The invention consists in depositing a thin film of zinc on a suitable cathode, in electrodepositing thereon a thin film of cobalt or cobalt alloy and in subjecting the plated cathode to dilute acid to thereby dissolve the zinc and effect the separation of the insoluble film, and in finally annealing the separated film in a hydrogen atmosphere.

Electricity and Gas versus Smoke.

The possibilities of making gas the universal fuel for city use have been considered by Mr. C. A. Smith. The author calls attention first to a prophetic utterance of Sir Oliver Lodge, made about twenty-five years ago, when speaking of the smoke problem. He said: "electricity is not going to supersede gas any more than it is going to supersede coal. What is, I hope and trust, going to be superseded by gas and electricity together is that abominable nuisance, smoke." The author holds that gas is not a desirable illuminant because it is dirty; that electricity should be substituted for it. Should this be done, there would be no further necessity for the gas companies to enrich their product for illuminating purposes. They could therefore produce a cheap gas for fuel purposes. This should take the place of coal, and in this way smoke would be done away with in the cities. Electricity can not hope to compete with such a fuel for heating purposes. A comparison is then made of electrical and gas transmission, the idea being to place the generating station at the mine and transmitting, in each case, the product to the cities. It is thought that the cheapest solution would be to transmit the gas, which would be used for heating purposes and for generating electricity at the city, the energy in this form being used for lighting. This plan would also reduce the cost of electricity, because it is believed to be very much cheaper to transmit the fuel in this way than it is to carry coal. Although all expect, and hope, that some day heating and cooking will be done by electricity, at present it is not practicable for it to be adopted universally. Every one should welcome, therefore, all efforts to produce cheap gas, which would not only assist in abolishing the smoke nuisance, but help to cheapen electrical energy.—*Electrical Review (London), May 25.*

Methods of Getting New Business.

A department devoted to the commercial development of Central Stations. Managers are invited to contribute suggestions for methods of increasing the demand for electric service.

One of the most interesting and instructive papers read before the recent convention of the National Electric Light Association at Atlantic City, N. J., was that compiled and written under the direction of John F. Gilchrist, entitled "Free Electric Signs as a Factor in Central Station Prosperity, and a Report of Electric Sign Conditions in the United States." It is to be greatly regretted that owing to the lateness of the hour this paper was read very hurriedly, and but little time was given to its discussion. Apart from the text, the paper was handsomely illustrated with half-tone reproductions of electric signs as installed in various parts of the country. A few abstracts from this paper will be interesting at this time:

"A conservative estimate of electric signs in the United States places the number at 75,000, consuming an average of not less than 480 watts per hour each, or a grand total of 36,000 kilowatts per hour. At an average of eight cents per kilowatt-hour, the hourly income from these signs would be $2,880. The nightly income, averaging four hours per night, would be $11,520, and the yearly income, a total of $4,204,800.

"The total population of towns under 10,000 was 2,885,942, and the total number of signs, 1,971, making a sign for every 1,464 people. In towns between 10,000 and 20,000, where the total population was 1,468,345, there were 1,112 signs, or one sign to every 1,320 people. In towns between 20,000 and 50,000 there were 2,198 signs to 3,205,493 people, or one sign to every 1,458 people. And in the large cities of over 50,000 with a total population of 16,228,984, there were 18,682 signs, or one to every 870 people.

"There are two propositions largely used by different lighting companies. One is for the lighting company to buy the sign and to install it free for a customer, provided the latter agrees to burn a minimum amount of current per month and for a certain length of time. The amount and time are fixed so that the lighting company is justified in making the expenditure for the sign. The other proposition is for the lighting company to charge a flat weekly or monthly rate for the use of the sign and current. This rate also is sufficient to pay for the current consumed, about twenty per cent per annum on the initial investment of the sign, and any other expenses incidental to the proposition.

"At the present time ninety-six of the 1,188 lighting companies answering the question are using one of these two free propositions and, except in a very few cases, are extremely favorable to it. These ninety-six towns, with a population of 10,047,648, have 12,000 signs, or a sign to every 837 people; while the remaining 1,092 towns, with a population of 13,741,116, have 11,963, or a sign to 1,149 people. The general effect of this method of encouragement is decidedly apparent.

"A bright, clean-looking sign is of more value to the merchant, giving a neat, business-like look to his store, which will mean a renewal of his contract when it expires. Certainly, nothing is much less attractive than a dirty, uncared-for sign. A certain large light company with a liberal free proposition and an efficient sign service tried the experiment of cleaning the sign, renewing lamps and making small repairs free of charge on all the old signs which had been on its lines before their free proposition had gone into effect. Many of these had burned irregularly for some time; others did not even make a pretense of burning, having become badly out of repair. All were dirty and were a big drawback to the effectiveness of the company's free proposition. A careful record was made and it was found that the increased current consumed by those signs, with full number of lamps always burning, paid the cost of the service, to say nothing of the advertising value of clean, well-kept signs.

"Turning the current on or off is a service which will increase electric-sign patronage to an appreciable degree and has an especial bearing upon the renewing of contracts. If the light company has a large number of signs the matter is a simple one, for the cost per sign of the patrolling is very low. Where the company has this policy it is desirable to have two specified times for termination of the evening's burning, such as ten and twelve o'clock. In towns where signs are few and far apart, or are to be switched on and off at many different times, the time clock may be used, although not particularly satisfactory. In general, the value of this kind of service can readily be seen, inasmuch as a sign owner can not very well, or will not, attend to these small matters for his one sign, and they mean a trouble and expenditure out of all proportion to the value and nature of the service rendered.

"One inducement which many central stations are making is a special sign current rate. Some central stations even prefer this to a free proposition on account of the absence of any financial investment. This is good as far as it goes, but the argument is poor. In the first place, the net income from signs is much lower in towns with a special current rate only than in the free-proposition towns.

"The small dealers either do not have the capital, or will not risk from $25 to $200 or $300 of their reserve fund in an initial investment of this kind. It is this class of trade for whom the free proposition was created and to whom it appeals. These small merchants have been known to pay a flat rental rate of from $8 to $10 a week, where they could not be induced to buy a sign at any price. In short, they wanted a good sign, but couldn't afford to, or wouldn't, buy it outright. But the bulk of these small men can be induced to pay from $1.50 to $6 a week in flat rates, which include the cost of the sign if the sign is furnished free.

"Of the total 1,188 stations, 158 made a special current rate for electric signs, with an average reduction of thirty-eight and one-half per cent. Thirty-nine of these had free propositions, and in these towns there was one sign to every 730 people. In the remaining 119 towns without free propositions there was one sign to every 800 people.

"Another popular method of encouraging the installation of signs is for the lighting company to have the sign billed through them, and thus give the retail sign purchaser the benefit of their dealer's discount. Still other methods are to connect or hang the sign free, or at least cost of materials and labor. In other words, it is necessary or desirable for the central station to show that it is ready to cooperate in every way possible by helping to bear the initial financial strain and by giving thorough and efficient service."

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

Westinghouse Motors.

The problem which confronts the purchaser of motors is very complex, involving as it does the question of so applying motors that they may more than pay the interest on the investment, and installing such motors that the repairs and depreciation do not become a formidable item of operating expense.

The first consideration involves the proper application of the motors, while the second relates to the selection of the make of motor to perform the work which it has to do with certainty and absolute reliability as regards continuous operation.

The Westinghouse Electric and Manufacturing Company from its inception has strictly adhered to the policy which has placed all the interests with which George Westinghouse is connected on such a high plane. Their aim has been to put upon the market the best product which brains can devise and perfect manufacture construct.

For textile, flour and cement mills, the Westinghouse induction motors are particularly adapted, being sparkless, eliminating danger from fire, and on account of the class of labor frequently employed, the simplicity in operation of the Westinghouse motors is an important item. Their simplicity of construction, involving as they do no commutators and consisting practically of but two parts, a stator and rotor, places them, so far as attendance is concerned, on a par with line shafting.

The type "S" and "SA" motor for direct-current service, in, for example, the driving of machine shops, elevators and the like, are also standards in motor construction.

In the various lines of Westinghouse motors, the split bearings, front and rear alike interchangeable, enabling bearing replacements to be made without removing pinion or pulley, two oil rings on each bearing maintaining copious lubrication, babbit, which is the result of exhaustive tests, liberal mechanical and electrical design, are features which apply to all of the motors manufactured by the company.

Of the standard types might be mentioned the type "CCL," type "CC," type "F" and type "H" for alternating-current service, type "S," type "SA," type "K" and type "R" for direct-current service.

A brief description of the various motors, together with some mention of their fields of usefulness, may be of interest.

ALTERNATING-CURRENT MOTORS.

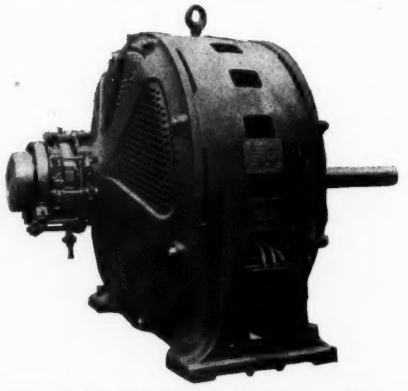
Type "CCL" polyphase induction motors are made in size from one-half horse-power to seventy-five horse-power. The motor consists of two parts, a stationary primary and rotating secondary. The rotating element is carried by two bearings supported by split and brackets, which are bolted to the solid cast-iron frames. The line circuit is connected to the stationary winding, and the rotor being of the squirrel-cage type, no sliding contacts are necessary for introducing current to the rotating element. The only wearing parts of the machine are the bearings, which, on account of their liberal design and rigid construction, require no adjustment. In the design of the type "CCL" motors, mechanical considerations have been given due importance, as evidenced by the liberal air gaps employed between the stationary and rotating element. Such a motor can be placed in any convenient location with but little regard to its accessibility, the starting devices being placed wherever convenient, and modern practice frequently groups a number of these starters at one point. The only attention required by the motor itself consists in occasionally supplying oil to the bearings. These bearings are split and interchangeable, front and rear. They are provided with two oil rings, furnishing a flooded lubrication.

TYPE "CCL" POLYPHASE INDUCTION MOTOR.

Type "CC" single-phase induction motors are made in sizes from one-quarter to ten horse-power. In many localities polyphase current is not available and the single-phase motor must be used. They are designed and constructed for severe service, are reliable and efficient in operation and possess a minimum of complications. The self-oil bearings, the starting device, which can be placed in any convenient location, and the clutch pulley, enabling the motor to pick up its load easily, are the principal features of the single-phase "CC" motors. The "CC" motors are also built polyphase in sizes of one-quarter to one-half horse-power. They require no starting device.

TYPE "CCL" SINGLE-PHASE INDUCTION MOTOR.

Type "F" variable-speed induction motors are made in sizes from one to five hundred horse-power, and have been designed to meet the demand for a variable-speed motor operating from alternating-current circuits. The essential difference between the type "F" and type "CCL" consists in the employment of the wound secondary instead of the squirrel cage; similar, as regards winding, to the alternating-current generator armature. This winding is connected through brushes and collector rings to an external resistance which may be varied by means of a con-



TYPE "F" VARIABLE-SPEED INDUCTION MOTOR.

troller, usually of the drum type. The type "F" motors are suited to variable-speed work, such as hoists, cranes, dredges, etc., and may also be used in connection with fans, blowers and pumps. The varying nature of the work required of type "F" motors necessitates the employment of resistances suited to the work in hand.

Type "H" constant-speed induction motors are made in sizes from five to seventy-five horse-power. These motors are designed particularly for operation at constant speed where the starting conditions are severe. They will start a given load with a minimum current, and are therefore particularly adapted for use on distributing systems which are sensitive or whose regulation would be seriously affected by sudden and severe changes of load. They are thus peculiarly adapted for use on lighting circuits, etc.

DIRECT-CURRENT MOTORS.

Type "S" direct-current motors are

TYPE "H" CONSTANT-SPEED INDUCTION MOTOR.

made in capacities from one to 110 horse-power and have been designed with the idea of furnishing a rugged motor adapted to belt and gear connection. The type "S" motor is extremely flexible as regards its application, there being somewhat over 700 ratings obtainable on thirteen frames, and the same machine is well adapted to either constant or variable-speed service. The rugged construction is maintained throughout the line, split bearings interchangeable front and rear, heavy shafts, substantial frames, improved shunted brush holders and heavy brush-holder rigging are some of the principal characteristics. The wearing depth of the commutator is exceptionally great. Modifications of the type "S" motor are readily obtainable, such as, for example, shunt or compound windings, but one which has met with universal favor is the so-called bending roll motor. This machine is provided with an exceptionally heavy series winding in combination with the restraining shunt; the starting torque is comparable with the series-wound machine,

TYPE "S" DIRECT-CURRENT MOTOR.

but the shunt winding prevents the motor from attaining an excessive speed. Among the other modifications of the type "S" motor is the elevator motor, which is a compound-wound machine provided with a split-series coil, which may be cut out in two sections, thus adapting the machine to elevator service.

Type "SA" direct-current motors are essentially a variable-speed motor, provided with an auxiliary pole, insuring perfect commutation through a speed range as high as one to four. The control is obtained by field control, and the employment of the type "SA" motor insures satisfactory operation where variable speed is required combined with a maximum simplicity as regards wiring.

Type "K" direct-current motors are made in capacity from three and one-half

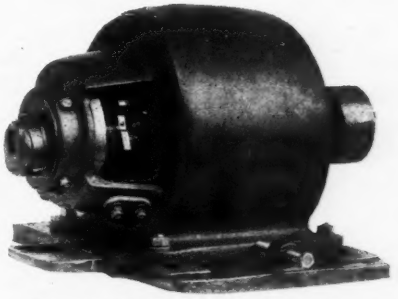
TYPE "SA" DIRECT-CURRENT MOTOR.

to forty horse-power, are series wound, and particularly designed for crane hoisting and similar service. They represent the latest development in motors of their general type, and many new features of practical value are incorporated in their construction. Among these may be mentioned split frames and bearings, rigid shafts and design of shunted brush holder, together with comparatively slow speeds, minimizing gear reduction and insuring long life and a minimum of repairs. The motors themselves are compact, convenient to install and allow of considerable flexibility in the matter of mounting. The frames are enclosed, guarding against dirt and moisture, but are so arranged that the working parts are readily accessible for

TYPE "K" DIRECT-CURRENT MOTOR.

inspection without dismantling the motor itself.

Type "R" motors have been produced to meet the demand for a thoroughly reliable machine of small power, which shall be easy to install and may be operated by



TYPE "R" DIRECT-CURRENT MOTOR.

the inexperienced, giving continuous service throughout a long life. Their capacities range from one-sixth to one and three-quarters horse-power. The fields are shunt wound, and a number of different horse-power ratings and speeds are obtainable on the various frames. Many features of importance, often regarded as unnecessary on small machines, have been incorporated in the type-"R" motors. Among the important features may be mentioned rigid shafts, interchangeable bearings, front and rear, the bearing being of simple form which may be duplicated by the ordinary machine shop at a trifling expense, and brush-holder adjustment

maintaining the relation between commutator and brushes, thus obviating regrinding when brushes are adjusted, together with solid frame construction, which in a measure protects the commutator and brush holders. The motors operate sparklessly between no load and an overload of fifty per cent; within this range the brushes require no adjustment. On the two larger sizes the same type brush-holder construction is used which the Westinghouse Electric and Manufacturing Company is at the present time furnishing on large engine type generators.

Niagara Falls from an Economic Standpoint.

An interesting discussion of the economic value of Niagara falls has been contributed to *The Outlook* by Mr. H. W. Buck, electrical engineer of the Niagara Falls Power Company. Mr. Buck lays aside æsthetic considerations, and points out the value of the falls purely as a source of power. The total hydraulic energy of the falls, if all were developed, would represent about 3,500,000 horse-power. To generate one horse-power continuously for a year by a steam engine requires about thirteen tons of coal, so that to generate the amount of power represented by the falls would require about 50,000,000 tons of coal per year. This would cost not less than $50 per horse-power-year. As against this, Niagara power can be generated and sold in large quantities for $15 per horse-power-year, or $35 less than is possible from the use of coal and the steam engine.

"From the above it will be seen that if all the hydraulic energy of the falls were utilized for power purposes there would result to the country an annual saving of $122,500,000, and an additional saving in the consumption of 50,000,000 tons of coal. These figures illustrate what it costs the people of this continent actually to maintain Niagara falls as a spectacle. They represent the saving to those who would consume the power, and not the profit of those who own the power developments. This waste involved in prohibiting the development of Niagara power might be likened to a great conflagration, in which 50,000,000 tons of coal were annually consumed. Such a conflagration might be one of the most magnificent sights in the world, and people might come from all parts to view it, but the human race would certainly be justified in using every effort to stop the waste by putting out the fire."

Mr. Buck also calls attention to the various industries which have sprung up since cheap power has been available at Niagara, and says that if all the power which has yet been granted in franchises to various companies should be developed there would be available only about thirty-five per cent of the total energy of the falls, and it is not probable that such diversion of water would affect appreciably the appearance of the flow over the falls. The eye judges a waterfall largely by two elements—height and width, and the diversion of water from the crest of the falls will not influence the appearance in any respect. Moreover, the magnificent beauty of the lower part of the river and of the Whirlpool rapids would not in any way be affected. The laying bare of the American falls by the diversion of water on the Canadian side can be averted by deepening the channel of the former.

Mr. Buck concludes: "The economic side of the Niagara problem is a serious one, and it can not be set aside as secondary to that of the scenic interests. It must be cleared of the prejudices which now discredit it, and its importance to the country at large must be recognized. Niagara falls is a great continental asset, not only as a scene, but also as a source of power; and any fair adjustment between the two interests must be made upon the basis of a reasonable compromise. The wave of exaggerated sentimentalism now passing should not be allowed to sweep aside all reason, nor be the only thing considered."

Editorially, *The Outlook* does not accept Mr. Buck's view. It says that while believing that every man, woman and child in the country should be well housed, well clothed and well fed, the material wants of American citizens should be so well supplied that the physical powers of each individual may be developed to the highest possible state of perfection. That this is not all that the country needs: it needs pictures, books, poetry, philosophy, symphony, the love of nature, and the education of the mind and spirit. That the tendency in America during the last two centuries has been to develop a love for material welfare at the expense of æsthetic beauty, and that any reaction from this tendency is beneficial. That this country can very well afford to maintain its parks, its public waterways and its mountain preserves, and can even afford to add to them. It is thought that the controversy over Niagara falls is one of the most important of its kind that has ever demanded public attention, and that when the case is thoroughly understood by the people at large they will quietly and calmly decide to preserve Niagara falls from the encroachments of commercial industry, and "will devote themselves, if necessary, with scientific skill and patience, to the discovery of some other means of supplying cheap economic power, which, we trust, some day will make electric lighting and street car travel and useful manufacturing much more general and much less costly than the managers of the Niagara power companies have been able or willing to make them."

New Electrical Power Schemes for India.

Messrs. Killick, Nixon & Company and Messrs. John Fleming & Company, both of Bombay, India, are applying for a franchise, under the Indian Electricity Act of 1903, to utilize the power to be obtained from the river Hooghly, in the southern part of British India. These two firms, says the *Indian Electrical, Mechanical and Textile News* (Bombay), are jointly floating a large and ambitious scheme. So far as area goes, they propose to serve both banks of the Hooghly river for a distance of twenty-five miles to the northward to the town of Hooghly, and seventeen miles southward to Budge-Budge, a total distance of forty-two miles. Mains are proposed to be run along each bank, and the area they cover will embrace practically the whole of the mills and factories of the Calcutta district, which are at present using 125,000 horse-power, at a rough estimate. The scheme is primarily one for the supplying of electric power for industrial enterprises, but it will also include supplying in bulk to distributors and for electric traction. No lighting powers are requested for direct use save in the case of persons obtaining power who also wish to light the premises to which that power is supplied.

For the commencement one generating station will be built, but it is projected ultimately to build two to obviate any risk from a breakdown. It is not proposed to seek powers to supply energy within the limits of Calcutta and Howrah, which are already covered by the license of the Calcutta Electric Supply Corporation. Rights will be sought to lay trunk mains through these areas. The draft license asks for the adoption of two systems of supply—a two or three-wire, direct-current system at 600 volts pressure between the outer wires and a single-phase or polyphase alternating-current system at 10,000 volts.

The capital of the company which will work the license, if it be acquired, has been provisionally fixed at £300,000. The present idea is to raise the capital in England, though, of course, if there should be a prospect of raising the money locally it might, to a certain extent, be taken advantage of.

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

WESTINGHOUSE COMPANY BUYS BELGIAN PLANT IN MOSCOW—It is announced that the $3,000,000 construction plant of the Central Electric Company, the last important Belgian enterprise in Moscow, Russia, has been purchased by the Westinghouse company for $2,000,000.

ELECTRIC COMPANY MERGER—A deal has been completed, by which the York Haven Power Company has absorbed the Harrisburg Electric Light, Heat and Power Company, with a capital of $2,000,000. The York Haven company has a power plant operated by water power from the Susquehanna river at York Haven.

NORTHERN COLORADO POWER COMPANY FILES MORTGAGE—The Northern Colorado Power Company filed a mortgage at Greeley, Col., on May 26, for $3,000,000 to the Central Trust Company, of New York, for the purpose of securing $3,000,000 in bonds for the Northern Colorado Power Company. The plant, to be located in Weld county, four miles south of Erie, will cost $1,500,000.

STOCK OF THE CHICAGO RAILWAYS COMPANY SOLD—The stock of the Railways company, which is nominally capitalized at $10,000, has been purchased by interests representing the Chicago Union Traction Company and the North & West Chicago Companies. F. H. Rawson, president of the North & West Chicago Companies, was elected president, and Henry H. Blair, receiver of these companies, was elected vice-president. It is stated that a satisfactory ordinance has been agreed upon with the Chicago city authorities.

THREE-MILLION-DOLLAR LIGHTING COMPANY—The agreement of consolidation between the Electric Lighting Company, of Mobile, and the Mobile Electric Company, forming a $3,000,000 corporation for lighting purposes in Mobile, has been filed. Papers of incorporation of the new lighting company, which will be known as the Mobile Electric Company, have also been filed. The president of the company is C. E. Groesbeck; vice-president, John J. O'Brien; secretary, James S. Cummins; treasurer and assistant secretary, N. P. Zech. The incorporators are: C. E. Groesbeck, N. P. Zech and S. S. Schaffner.

UPPER OHIO VALLEY TRACTION MERGER—A deal has been consummated merging a number of upper Ohio valley traction systems, by which Cleveland, Pittsburg, Buffalo and Wheeling will be connected by street railways. The entire deal was financed by Buffalo and New York capitalists, with W. Caryl Ely, of Buffalo, N. Y., president of the Ohio Valley Finance Company, managing the transaction. The companies will operate sixty miles of river front electric railways. Among the companies purchased is the East Liverpool Traction and Light Company, owning the street railway lines to East Liverpool, Wellsville and Chester, W. Va.

EXTENSIVE INSTALLATION OF TELEPHONES IN DEPARTMENT STORE—Two thousand Bell telephone instruments have been put in place in the new Wanamaker department store, Philadelphia, Pa. There are over 100,000,000 feet of wire within the store, and the system is served by twelve operators. A telephone has been located at each counter, with automatic coin boxes attached. The store is connected with the telephone company's central office by 120 trunk lines. The system is intercommunicating, so that any part of the store can be reached from any counter. As the store grows, the system will be widened out, the switchboard being available for 6,000, 8,000 or 12,000 telephones, as the future may require.

PHILADELPHIA COMPANY TO INCREASE CAPITAL STOCK—The stockholders of the Philadelphia company have been called to meet on August 14, at Pittsburg, Pa., to act upon a proposition to increase the capital stock from $36,000,000 to $42,000,000. The increase will consist of 120,000 shares of common stock at $50 per share. The proceeds will be used to pay for the stocks of the Beaver Valley Traction Company and the Washington & Canonsburg Railway Company, both of which were purchased last year, and also to provide additional power for the increasing of the business of the Allegheny County Light Company and the Pittsburg Railways Company, and to make other necessary improvements and extensions.

NO FRANCHISE FOR THE NEW TELEPHONE COMPANY IN NEW YORK CITY—The board of estimate, New York city, has requested the New York Telephone Company to file, within thirty days, a petition praying for the consent of the local authorities for a franchise or right for the privileges which it now enjoys, and a statement stating the terms and conditions upon which it is willing to accept such a franchise. The company also is to yield to the city possession of the Empire City Subway Company's subways. The bureau of franchises has recommended to the board that if the New York Telephone Company agrees in writing to do certain things, the proposed franchise for the Atlantic Telephone Company be not granted.

ANOTHER COMPANY ASKS FOR TELEPHONE FRANCHISES IN NEW YORK CITY—The United States Automatic Telephone Company has filed with the secretary of the Board of Estimate an application for a franchise to construct and operate a telephone system in New York city. The company wants a franchise to operate a telephone system and the right to use all subways and ducts now in existence and to be constructed. The company offers to put in telephones at a charge of $12 for residences and $24 per year for business houses, with a charge of two cents in each borough, and ten cents for toll calls to any part of the city. It also offers to supply each city department, hospital and charitable institution with one telephone free for 1,000 calls a year, and two cents for each call above 1,000.

NEW PUBLICATIONS.

REPORTS FROM THE NATIONAL ELECTRIC LIGHT ASSOCIATION—The National Electric Light Association has published its annual reports on "Municipal Lighting Statistics" and "Rates for Commercial Lighting and Power Service." These very valuable books are for the confidential use of members only.

"THE TRUTH ABOUT THE ASPHALT TRUST"—A pamphlet, entitled "The Truth About the Asphalt Trust" has been published by Ivy L. Lee, 20 Broad street, New York city. This pamphlet contains a statement setting forth the history, existing organization and present policy of the General Asphalt Company, sometimes called the "asphalt trust."

A REPORT UPON THE ISTHMIAN CANAL—A very interesting pamphlet which has recently been published by Lindon W. Bates, consulting engineer, 111 Broadway, New York city, contains a copy of Mr. Bates' hearings before the Senate Committee on Interoceanic Canals. This hearing is composed, for the most part, of a statement by Mr. Bates concerning a plan which he has developed for the carrying out of this enormous engineering problem. This pamphlet is certainly a very interesting and instructive addition to the literature of the subject. Preceding the official text there is a four-page résumé which includes a parallel arrangement of the Bates' project and the project of the board of consulting engineers for a sixty-foot lock canal. This résumé also takes up the following points: "Comparative Contract Estimates; Majority and Bates' Prices Compared"; "Fallacies of the Minority's Eighty-five-foot Lock Plan"; "Defects of the Sea Level Plan"; "Epitome of Criticisms on Sea Level and Eighty-five-foot Canals on Hearings before Senate Committee."

OBITUARY NOTICE.

MR. FREDERICK S. COOLIDGE died on Friday, June 8, at Fitchburg, Mass., aged sixty-five years. Mr. Coolidge was a member of the fifty-second Congress from the eleventh Massachusetts district. Since his congressional service he had been very much interested in street railway construction, and was president of the Gardiner, Westminster & Fitchburg Street Railway and a director of the Northampton & Amherst, Turner's Falls and Connecticut Valley lines.

NEW INCORPORATIONS.

JACKSON, MISS.—Columbus Light and Traction Company. $150,000.

AUSTIN, TEX.—Southwestern Telephone Company, of Beaumont. Capital increased from $50,000 to $100,000.

COLUMBUS, OHIO—Wadsworth & Western Traction Company. Increase of capital from $10,000 to $50,000.

ST. PAUL, MINN.—Citizens' Telephone Exchange Company, Montevideo. Increase of capital stock to $50,000.

INDIANAPOLIS, IND.—Marney Electric Company, of Indianapolis. Capital increased from $90,000 to $150,000.

DENVER, COL.—Phillips County Telephone Company. $1,000. Incorporators: S. S. Worley, A. C. Canble, E. E. Worley.

MADISON, WIS.—The Premier Lighting Company, Milwaukee. $5,000. Incorporators: A. J. Meyer, J. E. Hess and E. E. Meyer.

PORTLAND, ORE.—Mount Hood Electric Railway Company. $5,000. Incorporators: S. B. Cobb, C. W. Pallett and C. W. Miller.

OKLAHOMA, OKLA.—The Coyle Telephone Company, of Coyle. $5,000. Incorporators: O. L. Jewitt, C. L. Minnish and G. H. Stagner.

OLYMPIA, WASH.—American Electric Company, of Seattle. $5,000. Incorporators: G. A. Hastings, N. A. Prescott and J. R. Bosch.

SPRINGFIELD, ILL.—West Side Telephone Company, Millstadt. $1,140. Incorporators: William Kropp, Jacob Fischer and G. A. Mueller.

PORTLAND, ORE.—Oregon Electric Railway Company, Portland. $2,500,000. Incorporators: Thomas Scott Brooke, H. L. Corbett and R. W. Lewis.

ALBANY, N. Y.—Ellicottville Electric Light Company. $5,000. Directors: James G. McMahon, Michael Murphy and Eugene Hickey, of Ellicottville.

MADISON, WIS.—The Oosburg Telephone Company, Oosburg. $3,000. Incorporators: G. J. Huibregtse, Edward Was and J. Edward Huibregtse.

BISMARCK, N. D.—Home Telephone Company, Wahpeton. $10,000. Incorporators: Robert H. Divine, George E. Wallace, W. L. Carter, Wahpeton.

ALBANY, N. Y.—The Prattsville & Lexington Telephone Company. $600. Incorporators: J. Packham, B. G. Morse, G. D. Roppleyea, Prattsville, N. Y.

GUTHRIE, OKLA.—The Clinton Mutual Telephone Company, Clinton. $1,000. Directors: F. G. Cope, J. D. Kiletrell and F. A. Wadleigh, all of Clinton.

TOPEKA, KAN.—Topeka Electrical Company. $200,000. Incorporators: C. R. Maunsell, George H. Whitcomb, J. W. O'Neill, J. W. Going, Warren M. Crosby.

NASHVILLE, TENN.—Indian Mound Telephone Company, Stewart county. $2,000. Incorporators: J. B. Lahiff, H. B. Smith, J. I. Tippit, C. A. Moery and C. N. Keatts.

MILWAUKEE, WIS.—The Milwaukee Automatic Telephone Company, Milwaukee. $50,000. Incorporators: George J. Lonstorf, Ralph M. Friend and Joseph B. Doe.

COLUMBUS, OHIO—The Cleveland Heat and Power Company, Cleveland. $10,000. Incorporators: A. H. Miller, J. H. Miller, U. S. Mackey, C. N. Saxon and W. R. Purdy.

GUTHRIE, OKLA.—Farmers' Mutual Telephone Company, Mountain Park. $5,000. Incorporators: J. L. Collins, C. D. Williams, E. E. Kirk, J. H. Tarpley and J. E. Fairchild.

BARLOW, N. D.—The Farmers' Mutual Telephone Company. $15,000. Incorporators: J. R. Tingberg, John Indegard, L. Mortenson, E. H. Weigman, G. M. Carlson, G. G. Schmid, Barlow.

INDIANAPOLIS, IND.—Central Telephone Company, Greenfield. To operate a telephone system in Sugar Creek, Brandywine and Centre townships, Hancock County. $750. Directors: John Q. White, Louis J. Webber, Charles L. Scott, John C. Webber and Edward Jackson.

PIERRE, S. D.—Springs Mutual Telephone Company, with headquarters at Lebanon, Potter county. $5,000. Incorporators: John Nold, O. W. Beach, Joseph Tilgen and C. L. Keller.

COLUMBUS, OHIO—County Home Telephone Company, Grover Hill. $2,500. Incorporators: J. M. Hutchinson, D. D. Bailey, F. M. Saum, C. T. McClure, S. W. Strock, Joseph Bowman.

JEFFERSON CITY, MO.—Des Peres Valley Railway Company, of St. Louis. $50,000. Incorporators: John Scullin, Frank N. Johnson, Thomas N. Gallagher, John N. Maher and Edward S. Robert.

JACKSON, MISS.—Sumral Telephone and Telegraph Company, Sumral, Lamar county. To equip a private line from Sumral to Hattiesburg and Silver Creek. $5,000. Incorporators: J. R. Anderson, D. R. Campbell and others.

ALBANY, N. Y.—The Watertown Light and Power Company, of Watertown. $1,000,000. Directors: J. T. Lynn, of Detroit; J. D. McMahon, of Rome; C. C. Middleton, G. S. McCartin and E. R. Brown, of Watertown.

LINCOLN, NEB.—The Lone Tree Independent Telephone Company, of McClure township, Holt county. $12,000. Officers: J. M. Jackman, president; J. Reitz, vice-president; W. H. Garver, secretary, and Robert McClenahan, treasurer.

COLUMBUS, OHIO—The Chicago, New Washington & Bucyrus Railway Company. $500,000. Incorporators: A. M. Thomas, E. L. Williams, W. H. Foxall, K. I. Masterson and H. E. McCabe. To build an electric railway connecting Chicago, Ohio and Bucyrus.

COLUMBUS, OHIO—The Cleveland, Brooklyn & Elyria Railway Company, Cleveland. To construct and operate an electric railway connecting Cleveland and Elyria. $100,000. Incorporators: B. E. Ottman, L. J. Weadock, W. E. Elliott, R. J. Kalina and O. A. Thomen.

ALBANY, N. Y.—The Winona Lake Development Company, of Newburgh. To develop a power plant and to deal in real estate. $25,000. Directors: Albert N. Waring, Dwight H. Waring and Jessie I. Stone, of Newburgh, Matthew W. Innis and William Innis, of Orange Lake.

PIERRE, S. D.—Prairie Centre Telephone Company, Prairie Centre township, Clay county. To build a telephone line from Vermillion to Prairie Centre township. $5,000. Incorporators: H. P. Hanson, W. L. Brownson, C. H. Huetson, A. H. Lohre and J. N. Leer, all of Vermillion.

LITTLE ROCK, ARK.—Kings River Electric Light and Power Company, of Eureka Springs. To build and operate a system of urban and interurban lines in Carroll county, and to construct and operate a light and power plant. $75,000. Incorporators: G. W. Matthews, C. M. Barnes and A. E. Barnes.

BRIDGEPORT, CT.—Western New York Construction Company. To carry on the business of contracts for the construction of railways, gas, electric light and power transmission properties and other public and private utilities. $100,000. Incorporators: George H. Sellers and Arthur McCausland, New York, and William J. Bagnell, Brooklyn.

INDIANAPOLIS, IND.—Indianapolis, Decatur & Ohio Traction Company. To construct and operate a line of electric road from Bluffton to Decatur in Wells and Adams counties, running northeast from Bluffton to the Ohio-Indiana line. $10,000. Incorporators: H. R. Moltz, J. R. Tudor, J. B. Holthouse, G. A. Gessner, Jr., and S. N. Young.

SALT LAKE CITY, UTAH—Garfield County Telephone and Telegraph Company. To equip and operate telephone and telegraph lines throughout the state of Utah, the principal place of business being at Panguitch, Utah. $25,000. Officers: M. W. Steele, president; Thomas Levy, vice-president; R. G. Clark, Jr., secretary; J. G. Spencer, treasurer. S. O. Henrie, R. G. Clark, J. B. Showalter and the officers constitute the board of directors.

ALBANY, N. Y.—The Danbury & Portchester Railroad Company. To build and operate a standard gauge road, seven and one-third miles in length, from Salem Centre, Westchester county, to Ridgefield, Ct., thence through Lewisboro and Poundridge, N. Y., to a point at High Ridge, Ct. $100,000. Directors: J. G. Parker and Edward G. Buckland, of New Haven, and William Greenough, Charles M. Sheafe, Jr., Frank E. Hall and others, of New York city.

ELECTRICAL SECURITIES.

Speculation in stocks showed a slightly improved activity and appeared to gain strength last week, but it is the opinion of many that this was due entirely to professional operations. Many bankers and brokers say that they do not look for a million-share day for some time to come—probably not during the rest of the summer. Crops and the money outlook continue the dominant present financial and speculative forces. In the main, developments affecting these influences have been favorable. Much will depend upon whether the present promise of good crops is realized. Abundant harvests will mean prosperity in the agricultural communities, and this, in consequence, will mean large expenditures for all classes of manufactured products. The increased dividend of the Interborough Rapid Transit Company is to be noted, and also the showing of Amalgamated Copper.

ELECTRICAL SECURITIES FOR THE WEEK ENDING JUNE 9.

New York:	*Closing.*
Allis-Chalmers common	22¼
Allis-Chalmers preferred	58½
Brooklyn Rapid Transit	83⅞
Consolidated Gas	140
General Electric	171
Interborough-Metropolitan common	50¼
Interborough-Metropolitan preferred	84⅞
Kings County Electric	165
Mackay Companies (Postal Telegraph and Cables) common	75½
Mackay Companies (Postal Telegraph and Cables) preferred	74½
Manhattan Elevated	151
Metropolitan Street Railway	111
New York & New Jersey Telephone	137
Western Union	92½
Westinghouse Manufacturing Company	156

The directors of the General Electric Company have declared the regular quarterly dividend of 2 per cent on the stock, payable July 16 to stockholders of record June 13.

The guaranteed quarterly dividend of 1¾ per cent on the Manhattan Railway Company will be paid on and after Monday, July 2. Books closed June 15 and will open June 27.

Directors of the Interborough Rapid Transit Company have declared a dividend of 2¼ per cent on the stock, payable to voting trust certificates of record June 20, on July 2. Books close on June 20 and reopen July 2. The previous dividend was 2 per cent.

The regular quarterly dividend of 1 per cent on the preferred shares and a dividend of 1 per cent (at the rate of 4 per cent per annum, payable quarterly), on the common shares in the Mackay Companies, will be paid on July 2, 1906, to shareholders of record as they appear at the close of business June 16, 1906. The transfer books will be closed from June 18 to June 30, 1906, inclusive.

The board of directors of the Interborough-Metropolitan Company have declared a quarterly dividend of 1¼ per cent upon the preferred stocks, payable July 2, to stockholders of record upon the closing of the transfer books on June 13. The following information was placed before the board: "The dividends upon the stock of the Interborough Rapid Transit Company at the rate of 9 per cent per annum will furnish the funds required to pay the interest upon the collateral trust bonds of the Interborough-Metropolitan Company. The quarterly dividend of 1¾ per cent, payable on July 16, upon the stock of the Metropolitan Street Railway Company, will bring into the treasury of the Interborough-Metropolitan Company $740,741.75, an amount exceeding by $174,140.50 the quarterly dividend of 1¼ per cent on the outstanding preferred stock of the Interborough-Metropolitan Company. The auditors of the operating companies report that the earnings of the properties of the Interborough Rapid Transit Company and the New York City Railway Company since the formation of the Interborough-Metropolitan Company have exceeded the estimates which were made at the time of the organization of the Interborough-Metropolitan Company. For the first three months of the present calendar year the aggregate net earnings of the properties showed an increase of $1,189,924.22 over the corresponding quarter of the preceding year."

Boston:	*Closing.*
American Telephone and Telegraph	138½
Edison Electric Illuminating	246
Massachusetts Electric	72½
New England Telephone	135
Western Telephone and Telegraph preferred	91½

The directors of the New England Telephone and Telegraph Company have decided to increase the outstanding capital stock of the company by the issue of $3,965,500 of new stock to the stockholders at par. Each stockholder of record on June 20 will have the right to subscribe for the new stock in the proportion of one share for each seven shares held by him on that date. The right to subscribe will expire on July 18, 1906. Payment for one-half of the amount subscribed for must be made on August 20, and for the other half on February 20, 1907. No interest will be allowed on subscriptions paid in advance. The new stock is issued for the purpose of providing funds for extensions of the property and for the payment of the fourth series of bonds, which is due in 1907.

May business of the Massachusetts Electric Companies was good, as compared with May a year ago. The general increase in gross earnings was between 7 and 8 per cent. This compares with an increase in gross earnings in April of 9 per cent and 8 per cent increase for March, as against a normal increase of about 5 per cent.

Philadelphia:	*Closing.*
Electric Company of America	11⅜
Electric Storage Battery common	73½
Electric Storage Battery preferred	73½
Philadelphia Electric	8⅜
Philadelphia Rapid Transit	25¼
United Gas Improvement	85

Chicago:	*Closing.*
Chicago Telephone	121
Chicago Edison Light	149⅞
Metropolitan Elevated preferred	72
National Carbon common	90
National Carbon preferred	120¼
Union Traction common	4½
Union Traction preferred	13

Chicago Telephone Company's gain in telephones for May was 2,388. The total now in use is 155,613.

LEGAL NOTES.

UNDER-RUNNING TROLLEY CASE—In the United States Circuit Court for the Northern District of Ohio, Eastern Division, on March 8, 1906, in the under-running trolley case, involving the Van Depoele reissue patent No. 11,872, the Thomson-Houston Electric Company, complainant, *versus* Henry Holland, *et al.*, defendants, it was ordered that a preliminary injunction be granted, restraining the defendants from making or selling any trolley stands or combined trolley bases and stands in the form exhibited by the complainant, or in any form which makes use of the invention and improvements of either of the claims of the said reissue patent.

CIRCUIT-BREAKER LITIGATION—The United States Circuit Court of Appeals for the Third District, sitting at Philadelphia, Pa., handed down a decision on May 24 in the case of the Westinghouse Electric and Manufacturing Company against the Cutter Electric and Manufacturing Company. The case involved the manufacture and sale of an automatic circuit-breaker, which the complainant alleged had been infringed by the Cutter company. In a previous decision of February 27, 1906, the court decided against the defendant, but a rehearing was asked for. The present decision is that on a reconsideration of the matter it is the opinion of the court that the Westinghouse patent is valid, and the circuit-breaker involved is an infringement thereof. An injunction and an order for an accounting will issue. The patent involved was granted to Wright and Aalborg, September 26, 1899, and is numbered 633,772.

ENGINEERING SOCIETY.

THE AMERICAN SOCIETY OF MODEL ENGINEERS—At the monthly meeting of the American Society of Model Engineers, held at the Berkeley Lyceum, New York city, on Wednesday evening, June 6, an interesting lecture was delivered by K. Stoye, instructor in the Baron de Hirsch Trade School, New York city. The lecturer explained the use of the lathe and lathe tools, with special reference to model making. The descriptions of some difficult operations on the lathe, as, for instance, deep, accurate boring or chucking of intricate pieces of work, and the use of the lathe as a shaper, were of particular interest. A discussion followed, manifesting considerable interest in the work. It was decided to adjourn during the summer months, and to commence early in the fall with a series of lectures and instructive talks interesting to model makers. W. E. Spon, 123 Liberty street, is the secretary of the society.

ELECTRIC LIGHTING.

PORT HENRY, N. Y.—Wallace Murray, of Saranac Lake, has applied for an electric light franchise in Port Henry.

ELMIRA, N. Y.—A power plant on the Taughannock creek is to furnish electricity for light and heat to Ovid, Sheldrake and Interlaken.

WILLIAMSPORT, PA.—New York capitalists have purchased the electric light plant of the White Clay Creek Supply Company, which lights Kennett, Avondale, West Grove, Londonberg and vicinity.

BIG RAPIDS, MICH.—J. P. Martiny has been awarded the contract for the building of the Grand Rapids-Muskegon Power Company's transforming station. The structure is to have a twenty-five-foot front, and will be sixty-three and a half feet deep and twenty-two feet high.

LANCASTER, PA.—The lamp committee of the Lancaster city councils has awarded the contract for arc street lamps to the Edison Illuminating Company, controlled by the Lancaster Railway and Light Company, for a term of five years at $80 per lamp per year. Last year the city paid the sum of $93.50 per lamp. This is a saving of $4,522.50 per year, or $22,612.50 in five years.

BATAVIA, N. Y.—The Batavia village board of trustees has voted to give a franchise to the Genesee County Electric Light, Power and Gas Company for the distribution of electric power in the village of Batavia. The franchise provides for the installation of the system inside of a year. The rates to be charged for light and power are as low, or lower, than those granted in Niagara Falls.

NIAGARA FALLS, ONTARIO—By an order of the Dominion Railway Commission, the Ontario Power Company has had extended for another ninety days the period during which it can erect and maintain wires for the transmission of electrical power over the tracks of the Grand Trunk, Wabash, Michigan Central, Canada Southern, Niagara & St. Catharines Railway companies and the Niagara Falls Park and River Railway.

FORT DODGE, IOWA—The final transfer of the Fort Dodge Light and Power Company to Childs, Hulswitt & Company has been made. The new officers elected are: president, O. M. Oleson; vice-president, Richard Schaddelee; secretary, Harry Morton. New members of the board of directors are: Richard Schaddelee, Ralph Childs, Frank Hulswitt, Howard Thornton, Harry Morton, and the old members reelected are: O. M. Oleson, T. F. Flaherty, D. M. Kelleher and M. J. Haire.

UNIONTOWN, PA.—Interests allied with the West Penn Company have filed applications for light, heat and power companies in Fayette, Washington and Westmoreland counties. The incorporators are: Jacob Van Wagener, John F. Cockburn and Clarence W. Schenck, all interested in the West Penn Company. The points where they expect to do business in Fayette county are New Haven, Vanderbilt, Everson, Smithfield, Fayette City, Bellevernon and Georges, and Washington township.

NEW ORLEANS, LA.—The officers of the Consumers' Electric Company have announced that their plant will be ready to furnish electricity within a few weeks. The plant is equipped with Westinghouse electric generators and machinery, and the boilers are of the most improved type. The smokestack is 268 feet high and fifteen in diameter. Jules Dreyfous, president of the company, said that contracts had been closed for lamps, meters and transformers, amounting in value to over $100,000.

DENVER, COL.—The Denver Gas and Electric Company at its annual meeting elected the old board of directors. The directors then elected officers. The directors reelected are: A. S. Hughes, J. B. Grant, Paul Doty, E. W. Rollins, H. C. James, Charles A. Frueauff, H. T. Rogers, W. J. Barker, Philip Cross and Irwin Butterworth, all of Denver. The new officers of the company are. H. L. Doherty, president; Frank W. Frueauff, vice-president and general manager; R. B. Sullivan, treasurer; C. N. Stannard, secretary; John T. Brady, assistant secretary. It was stated that the policy of the company will be to extend its system.

COLUMBUS, OHIO—The Cleveland Gas and Electric Company, of Cleveland, with $10,000 capital, has been incorporated by Samuel C. Powells, G. Lewis Meade, Rollin W. White, Joseph B. White and Charles A. Lieb. Half the stock is six per cent preferred. The Union Gas and Electric Company, of Cincinnati, was incorporated by the same persons. Like the first-named company, the capital stock is $10,000, divided into common and preferred in the same proportions. The purposes of the two corporations are identical, and enable the companies to own and operate city and interurban railways, natural and artificial gas plants and electric light, heat and power plants in the cities of their locations and elsewhere in the state.

GAINESVILLE, TEX.—The Washita Electric Power Company has been organized at Berwyn, I. T., with a capital of $250,000. The incorporators of the company are: Edward J. O'Beirne, of Atlanta, Ga.; William H. O'Beirne, of Gainesville, Tex., and Thomas C. Whitfield, of Berwyn, I. T. Work is to be commenced at once upon the construction of a power plant on the Washita river, in the Arbuckle mountains, five miles north of Berwyn, where the river passes through the mountains forming a series of continuous rapids over a mile down the cañon. The company will construct a dam above the rapids connecting with a series of canals that will convey water to the power-house located below the rapids, affording a sixty-foot head and developing over 20,000 horse-power.

PERSONAL MENTION.

MR. ALFRED M. MENDEL, Milwaukee, Wis., has been appointed a member of the Public Lighting Commission for the four-year term.

MR. WILLIAM G. ORR, Hartford, Ct., has been appointed superintendent of the electrical department of the Orange County Lighting Company, with headquarters at Middletown, N. Y., succeeding Mr. C. S. Warner.

DR. W. OSTWALD, the distinguished physical chemist, has resigned his position at the University at Leipsic. Dr. Ostwald has been at Leipsic for nearly twenty years. It is said that he retires in order to devote himself to literary and experimental work at his private laboratory at Grossbothen.

MR. FRANK G. HOUSER, auditor of the Spartansburg (S. C.) Street Railway, Gas and Electric Company, has resigned and will go to Boise, Ida. Mr. Houser will be connected with a new street railway line, the construction of which will be begun in Boise within a short time.

MR. THOMAS B. REDMOND has resigned as manager of the Mississippi Valley Traction Company. Mr. Redmond's headquarters were at Davenport, Iowa, where he has been located for nearly two years, going there from Saginaw, Mich., where he was general manager of several surface systems and an interurban street railway system.

MR. CLARENCE A. ROSS, who has been connected with the Westinghouse Electric and Manufacturing Company for the past eleven years, has placed his resignation with the company, to take effect July 1. Mr. Ross will be associated with a company to be known as the Engineering and Investment Company, whose purpose will be to finance and construct interurban electric railway projects. For the present the company will have offices in Chicago, Pittsburg and New York city.

MR. JOHN I. BEGGS has been presented with a bronze tablet by the department heads of the newly formed National Brake and Electric Company, in recognition of his services as trustee of the National Electric Company, Milwaukee, Wis. The tablet bears the following inscription: "Presented to John I. Beggs, trustee of the National Electric Company, Milwaukee, by the officers of the company as a mark of esteem of the manner in which he handled the company and its employés during the twelve months the National Electric Company was under his management, April, 1905-May, 1906." The names inscribed upon the tablet are: J. H. Denton, general superintendent; R. P. Tell, secretary and treasurer; J. L. Wailes, general sales manager, and W. L. Waters, chief engineer. Mr. Beggs has also been presented with a testimonial in the form of a leather-bound album from the employés of the Twelfth street station of The Milwaukee Electric Railway and Light Company, of which he is president. The album contains the autographs of the employés, together with an appreciation of the fact that their wages were voluntarily raised by the president.

ELECTRIC RAILWAYS.

ATLANTA, GA.—The Georgia Railway and Electric Company may in the near future construct a line to Stone Mountain.

NEW YORK, N. Y.—The new line of the New York City Interborough Railway Company in the Bronx has been put into operation.

CINCINNATI, OHIO—The city of Fremont has granted a franchise to the Lake Shore Electric Railway Company for an extension from Fremont to Sandusky, Ohio.

KANSAS CITY, MO.—The Dodson line will be operated as an electric road in the near future. Preparations are now being made for this by the Metropolitan Street Railway Company.

BRYAN, TEX.—At a meeting of the Bryan Business League it was resolved to make another effort to secure a trolley line between Bryan and College. A committee of fifteen citizens was appointed.

EVERETT, WASH.—T. C. Fleming has been granted an electric railway franchise by the board of county commissioners. The right-of-way for the franchise is from the south line of Snohomish county to the north line, *via* Everett and Marysville.

DAVENPORT, IOWA—The committee named by the business men of Davenport who are promoting the interurban project between Davenport and Muscatine has contracted for the survey of the two routes, one *via* Blue Grass and the other *via* Buffalo to Muscatine.

MILES, WASH.—The Big Bend Transit Company, grading and laying track across the southwest corner of the Spokane Indian reservation and preparing to dam the narrows in the Spokane river, has made a preliminary survey for its line along the south bank of the Spokane river between Miles and Spokane.

STEUBENVILLE, OHIO—The lines of the Steubenville Traction and Light Company, extending from Steubenville to Empire, with the power and light plants, lighting franchises and Stanton Park, have been sold to the Ely railway syndicate. Several million dollars will be spent in a double-track electric system to Beaver, Pa.

CANON CITY, COL.—A contract has been signed by the Canon City, Florence & Royal Gorge Interurban Railway Company for poles for the Royal Gorge division and for the stringing of the wires. Every effort is being made to complete the work by July 1, so as to have the line in full running order at the opening of the Elks' convention in Denver.

EVANSVILLE, IND.—Charles Murdock and Henry W. Marshall, of Lafayette, representing an eastern syndicate, have closed a deal whereby the Evansville & Princeton Traction line is to pass under their control. The purchase is a part of the syndicate's plan to build a traction line from Evansville to Indianapolis. The company which is to take over the property is capitalized at $600,000.

NEW YORK, N. Y.—Mayor McClellan has signed the franchise for the New York & Port Chester Railroad Company, to construct a four-track railroad across the borough of the Bronx, which was approved by the board of estimate. This is the first franchise that has been finally approved since the power to grant franchises was taken from the board of aldermen and vested in the board of estimate. As soon as the comptroller has approved the bonds required by the terms of the franchise, the company may proceed with the work of construction.

BROOKLYN, N. Y.—It is expected to have the Jericho plank road electric line of the New York & Long Island City Traction Company completed within the city limits by July 1, and the remaining section, from Queens borough line east to Franklin street, Mineola, by August 1. The line is being laid with ninety-pound girder rails, and fast service will be given over it. The line will be extended from Queens to Mineola, and westwardly from Queens connection will be made with Jamaica Village over the lines of the Long Island electric line.

MILWAUKEE, WIS.—A. C. Frost, president of the Chicago & Milwaukee Electric Railway Company, has reopened negotiations with the city council of Kenosha to secure a franchise for the extension of the lines of the company in that city. President Frost has offered to pave with macadam all streets passed over, to build a new steel bridge and to put in a local service at once. It is understood that the company is planning to utilize the proposed tracks for the through line, thus permitting it to run cars from Chicago to Milwaukee directly to the central part of Kenosha.

TELEPHONE AND TELEGRAPH.

BRIDGEPORT, W. VA.—The Belmont Telephone Company will extend its lines to Kirkwood Heights.

WINTHROP, MASS.—A new central energy switchboard is being placed in the Winthrop telephone exchange.

POUGHKEEPSIE, N. Y.—The Hudson River Telephone Company has installed a central energy system in Poughkeepsie.

RICHFIELD, UTAH—A branch telephone line is being built, connecting with the line between Richfield and Glenwood and extending to Venice, Siguard and Vermillion.

COLUMBUS, OHIO—The Sandusky Telephone Company has filed with the secretary of state a certificate increasing its capital stock from $75,000 to $200,000. George Frick is its president, and J. C. Houser, secretary.

WILLOWS, CAL.—The Willows board of supervisors has granted the Sunset Telephone Company the right to use five feet of the county road for poles. The company will rebuild the lines throughout the town and make a number of improvements.

BRANDON, N. Y.—A new telephone company has been organized in Brandon under the name of the People's Telephone Company, which will take over all the telephone properties in Brandon and operate them as a single system. The stock of the new company will have a par value of $10 a share.

MORGANTOWN, W. VA.—The purchaser of the People's Telephone Company has closed a contract with the Stromberg-Carlson Company for the new switchboard and equipment for the company's office in the Fleming Building. The contract price was $17,000, and the equipment is to be installed before October 1.

LEWISTOWN, MONT.—The Rocky Mountain Bell Telephone Company has bought the Lewistown Telephone Company. It is stated that not less than $100,000 is involved in the deal, by which the Bell Telephone Company becomes the owner of the recently completed copper line between Lewistown and Great Falls and the line to Kendall.

BERLIN, ONTARIO—The Bell Telephone Company has received a five-year franchise from the Berlin town council on condition that it remove its poles and place wires underground on certain streets. The company also agrees to give the town the free use of five telephones, and to allow the use of poles throughout the town for wires for a fire-alarm system.

ROCHESTER, N. Y.—It is stated that the managers of the Rochester Telephone Company are considering the advisability of establishing a branch exchange to take care of the business of the company which has outgrown a single exchange. The Bell Telephone Company established a second exchange in Rochester several years ago.

CHICAGO, ILL.—Plans have been completed for an addition to the Chicago Telephone Company's headquarters, northeast corner of Washington and Franklin streets. It will be a twelve-story modern office building, eighty by eighty feet, fireproof, with dressed brick, terra-cotta and stone front, hardwood finish, steam heat, wiring for electricity, marble, tile and mosaic work, and is estimated to cost approximately $750,000.

ALBANY, N. Y.—The United Message Company, of Albany, has certified to the secretary of state that it has increased its capital stock from $10,000 to $10,000,000. The company is an independent telephone concern. Of the capital stock heretofore authorized, only $700 has been actually issued. The stockholders who signed the certificate are: Howard Hendrickson, William A. Hendrickson, M. H. Teator, F. E. Griffin and C. J. Crummey.

NEW MANUFACTURING COMPANY.

PORTLAND, ORE.—Articles of incorporation have been filed for the Standard Electric Company, the incorporators being John C. Baird, Frank E. Harmar and Fred A. Waltz. The capital stock is $15,000. The company will deal in electrical and gas fixtures and equip power plants.

INDUSTRIAL ITEMS.

THE H. T. PAISTE COMPANY, Philadelphia, Pa., will be pleased to send bulletin No. 32, describing new taplets, attachment plugs and 250-volt and 125-volt rosettes.

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia, Pa., in bulletin No. 97 describes the application of the chloride accumulator in railway and central station lighting service in the cities of Milwaukee and Chicago.

THE PITTSBURG HARDWARE AND HOME SUPPLY COMPANY, Pittsburg, Pa., has just issued a very elaborate prospectus of the various lines which it carries in stock. Among others special attention is given to electrical apparatus and supplies.

THE ELECTRIC CABLE COMPANY, Bridgeport, Ct., has installed an underground conduit system for the American Railways Company at Altoona, Pa. This conduit system is laid in wooden trenches, the wires being embedded in "Voltax," the new insulating compound.

THE ALLIS-CHALMERS COMPANY, Milwaukee, Wis., in bulletin No. 1504 describes and illustrates Allis-Chalmers steam turbines and generators. This is a very handsome catalogue, and in addition to the text, numerous illustrations are given showing the details of the turbine and generator construction.

THE AUTOMATIC REFRIGERATING COMPANY, Hartford, Ct., will be pleased to send a new booklet describing the application of the automatic system of refrigeration. At the present time there is considerable enquiry concerning this form of refrigeration, and any one interested will do well to secure this booklet from the company.

WESTINGHOUSE, CHURCH, KERR & COMPANY, New York city, has published a very interesting booklet entitled "Work Done." This contains brief descriptions of some forty-four installations for which this company has been the engineer. In addition to the text there are numerous illustrations which give a good idea of the extent of the work.

THE ELECTRICAL TRADES EXPOSITION COMPANY, Chicago, Ill., has ready for distribution a handsome pamphlet calling attention to the second annual electrical show to be held at the Coliseum, Chicago, Ill., January 14 to 26, 1907. This pamphlet is retrospective and prospective, describing and illustrating the last show, and giving a word concerning the coming exhibition.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, Rochester, N. Y., reports having closed contracts for switchboards in the following places: Lansford, N. D.; Willow City, N. D.; Beaumont, Tex.; Page, N. D.; Colton, S. D.; Osawatomie, Kan.; Carter, Wis.; Chicago, Ill.; Galias, Me.; Sutton West, Ontario, Canada; Bedford, Ind.; Grimes, Iowa; Ames, Iowa; Larrabee, Iowa; Ludlow, Ill.; Dieterich, Ill.; Streator, Ill.; Hoople, N. D., and Ashland, Mo.

THE GREGORY ELECTRIC COMPANY, Chicago, Ill., has moved into a new works at Sixteenth and Lincoln streets. The new factory occupies practically a half block, is well equipped with electric traveling cranes and modern machinery, and has railroad facilities with a switch track running into the building. All the machine tools are electrically driven. The plant is a model one throughout, and especially designed for handling and repairing second-hand apparatus.

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., general western agent for "D. & W." material, is distributing copies of the new "D. & W." price list No. 11. This price list is small enough to be carried in the pocket, and quotes prices on "D. & W." fuses and safety devices. The company is also the western agent for "Deltabeston" magnet wire. New lists are being distributed, announcing a sharp reduction in the price of this wire. The company will be pleased to send this literature upon request.

THE HOLTZER-CABOT ELECTRIC COMPANY, Brookline, Mass., has ready for distribution bulletin No. 150A. This deals with annunciators and burglar alarms. Particular attention is directed to the restaurant call system, which consists of push-buttons and annunciator drops between the lunch counter and the serving room, furnishing a means of silent communication of orders. A sufficient number of buttons and drops are provided to allow one for each order of food on the menu. Any number of the drops may be worked simultaneously. In addition, a special tube and call bell is provided, by which special orders are transmitted.

THE SOUTHERN PACIFIC COMPANY, San Francisco, Cal., through its passenger department, has issued a very handsome pamphlet entitled "San Francisco, the Imperishable." This takes up the disastrous combination of circumstances which accomplished the fall of San Francisco, a word upon the many exaggerated reports, the estimated loss by fire, a description of the city rising from its ashes, and a few paragraphs upon the splendid spirit exemplified in "you can't down me" confidence. In addition to a map of San Francisco, showing the burned district, there are two large illustrations showing the comparatively insignificant damage done by the earthquake and the damage by fire, showing also how the substantial structures withstood both the earthquake and the fire.

THE WILLIAM ROCHE DRY BATTERY COMPANY, which has formerly had its factory in New York city, has equipped and is now operating a factory at 288 Clerk street, Jersey City, N. J. A large, centrally located, well-ventilated building, well adapted for the purposes of this company's manufacture, has been secured, and all its machinery has been installed. The company will continue a store at Park place and West Broadway, New York city. This company manufactures a "New Standard" dry battery which is manufactured for all open circuit work; also the "Autogas" type of battery which is adapted for automobiles, launches and ignition work. In the near future this company purposes to begin the manufacture of storage batteries. The president of this company, William Roche, has been identified with battery manufacture for many years, and it is believed that these recent moves will mean a renewed lease of life for the company.

THE WAGNER ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., distributed an attractive booklet at the convention of the National Electric Light Association at Atlantic City, N. J., last week. This gives a list of the electrical conventions in 1906, a description of the company's exhibit at the recent convention, the convention programme, delineates the Wagner progress from 1890 to 1900, gives a chapter on the output of the Wagner company, and some interesting reading matter on single-phase elevators, polyphase motors, transformers, instruments and domestic electrical apparatus. The company announces that the Denver territory will be handled and controlled by the Hendrie & Bolthoff Manufacturing and Supply Company, 1621 Seventeenth street, Denver, Col. This company has given a great deal of attention to posting its salesmen and traveling men on the characteristics and operation of the Wagner products, and the Wagner company announces that all enquiries for Wagner products will be handled in the best possible manner.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., which established its main office in the Union Savings Bank Building, at Oakland, Cal., immediately after the San Francisco disaster, as well as a local office at 1759 Geary street, in the burned city, has leased a suite of rooms in the new Monadnock Building, which it expects to occupy this week. For handling the present business, a half block of land has been leased in Emeryville, in close proximity to both the Santa Fé and Southern Pacific Railroad tracks. A temporary building is now about completed on this land for taking care of stock, and work has already been started on a new warehouse containing about 80,000 square feet, which will be located at the south end of the block bounded by Kansas, Rhode Island, Fifteenth and Alameda streets. At the temporary warehouse forty carloads of material have been housed, and nineteen carloads of additional apparatus are now in the yards waiting to be unloaded, with thirty or forty carloads *en route* from Schenectady. Additional cars are being shipped from the company's factories, so that the stock at San Francisco will soon be complete. At present the company is in excellent condition to fill orders as rapidly as before the fire.